Digitized by the Internet Archive
in 2010 with funding from
University of Toronto

http://www.archive.org/details/factoryindustria40newy

Factory and Industrial Magazine

I

517

25319

THE

ENGINEERING MAGAZINE

AN INDUSTRIAL REVIEW

VOLUME XL

October, 1910, to March, 1911

117297
13|7|11

NEW YORK
THE ENGINEERING MAGAZINE
1911

TA
1
F25
V.40

Copyright, 1911.
By JOHN R. DUNLAP.

INDEX TO VOLUME XL.

October, 1910, to March, 1911.

LEADING ARTICLES.

Accounting and Cost-Keeping System of the United States Navy *J. Mendenhall* 910
Achievements in New Zealand—Interesting Railway (Illustrated) *W. Wilson* 181
Administration, Municipal—An Influence for Efficiency in (Illustrated) *Herbert T. Wade* 585
Baker, Joseph B. Mail-Handling Plant at the New Pennsylvania Terminal (Illustrated) 711
Baxter, Sylvester The Electrification of a Commonwealth . 329
Bituminous Coal Mining—Division of Labor in *W. E. Fohl* . 175
Boiler Settings—Reinforced-Concrete *W. H. Weston* . . 563
Boyer, Jacques Recent Mechanical Improvements in the Manufacture of Illuminating Gas (Illustrated) 925
Brussels Exposition—The Destruction of the (Illustrated) . . 38
Building, Engine—Reducing the Costs of, by Efficiency Methods *Wm. O. Webber* 86
Business Man—The "Outsider" and the Busy *William Perry* . 249
Canal, Panama—Progress in the Construction of the (Illustrated) 389
Cement and Iron Industries; a Comparative Study (Illustrated) *Edwin C. Eckel* 854
Coal Mining, Bituminous—Division of Labor in *W. E. Fohl* . 175
Coal—The Purchase of, by Specifications (Illustrated) *Leo Loeb* 897
Cobalt in 1910 (Illustrated) *Arthur A. Cole* 15
Cole, Arthur A. Cobalt in 1910 (Illustrated) 15
Commonwealth—The Electrification of a *Sylvester Baxter* . . 329
Comparative Study—The Cement and Iron Industries; A (Illustrated) *Edwin C. Eckel* 854

Concrete Boiler Settings—Reinforced *W. H. Weston* . . . 563

Construction of the Panama Canal—Progress in the (Illustrated) 389

Corporations—The Organization of Great (Illustrated) *Wm. W. Mulford* 240

Cost Keeping in Small Factories (Illustrated) *Paul R. Powell* . 31

Cost-Keeping System of the United States Navy—Accounting and *J. Mendenhall* 910

Costs, Foundry—Systematic Foundry Operation and (Illustrated) *C. E. Knoeppel* 56, 201, 393, 553, 745

Costs of Engine Building—Reducing the, by Efficiency Methods *Wm. O. Webber* 86

Day, Charles Modern Machine Shops and Industrial Plants (Illustrated) 541, 729

Destruction of the Brussels Exposition (Illustrated) . . . 38

Development of Panama by Public Roads (Illustrated) *Edward Perry* 213

Division of Labor in Bituminous Coal Mining *W. E. Fohl* . . 175

Dreadnoughts—What Are They? (Illustrated) *Sidney Graves Koon* 521

Eckel, Edwin C. The Cement and Iron Industries; A Comparative Study (Illustrated) 854

Economics of Factory Ventilation *Royce W. Gilbert* . . . 339

Economy of Smoke Prevention (Illustrated) *J. A. Switzer* . . 406

Efficiency—Engineering in the Navy. Its Organization and *Ira N. Hollis* 673

Efficiency in Municipal Administration—An Influence for (Illustrated) *Herbert T. Wade* 585

Efficiency Methods—Reducing the Costs of Engine Building by *Wm. O. Webber* 86

Efficiency of Firemen—Smoke Prevention and the. A Concrete Instance (Illustrated) *J. A. Switzer* 83

Efficiency—The Twelve Principles of (Illustrated) *Harrington Emerson* 77, 161, 413, 496, 761, 943

Electrical Illumination—The New Era in (Illustrated) *Rollin W. Hutchinson, Jr.* 365, 507, 698

Electrification of a Commonwealth *Sylvester Baxter* . . 329

Electrification Problem on Trunk-Line Railways *A. D. Williams* 757

Emerson, Harrington The Twelve Principles of Efficiency (Illustrated) 77, 161, 413, 496, 761, 943

Engine Building—Reducing the Cost of, by Efficiency Methods *Wm. O. Webber* 86

Engineering in the Navy. Its Organization and Efficiency *Ira N. Hollis* 673

Engines, Lift-Valve—European (Illustrated) *Warren H. Miller* . 192

Era in Electrical Illumination—The New (Illustrated) *Rollin W. Hutchinson, Jr.* 365, 507, 698

European Lift-Valve Engines (Illustrated) *Warren H. Miller* . 192

Exposition, Brussels—The Destruction of the (Illustrated) . 38

Factories, Small—Cost Keeping in (Illustrated) *Paul R. Powell* . 31

Factory Ventilation—The Economics of *Royce W. Gilbert* . 339

Firemen—Smoke Prevention and the Efficiency of. A Concrete Instance (Illustrated) *J. A. Switzer* 83

Fohl, W. E. Division of Labor in Bituminous Coal Mining . . 175

Foundry Costs—Systematic Foundry Operation and (Illustrated) *C. E. Knoeppel* 56, 201, 393, 553, 745

Foundry Operation and Foundry Costs—Systematic (Illustrated) *C. E. Knoeppel* 56, 201, 393, 553, 745

Gas, Illuminating—Recent Mechanical Improvements in the Manufacture of (Illustrated) *Jacques Boyer* . . . 925

Gilbert, Royce, W. The Economics of Factory Ventilation . 339

Great Corporations—The Organization of (Illustrated) *Wm. W. Mulford* 240

Handling Plant—Mail, at the New Pennsylvania Terminal (Illustrated) *Joseph B. Baker* 711

Hollis, Ira N. Engineering in the Navy. Its Organization and Efficiency 673

Horsnaill, W. O. A Simple System for Jobbing and Repair Shops . 868

Hutchinson, Rollin W., Jr. The New Era in Electrical Illumination (Illustrated) 365, 507, 698

Illuminating Gas—Recent Mechanical Improvements in the Manufacture of (Illustrated) *Jacques Boyer* . . . 925

Illumination, Electrical—The New Era in (Illustrated) *Rollin W. Hutchinson, Jr.* 365, 507, 698

Improvements in the Manufacture of Illuminating Gas—Recent Mechanical (Illustrated) *Jacques Boyer* 925

Industrial Plants—Modern Machine Shops and (Illustrated) *Charles Day* 541, 729

Industries—The Cement and Iron; a Comparative Study (Illustrated) *Edwin C. Eckel* 854

Influence for Efficiency in Municipal Administration (Illustrated) *Herbert T. Wade* 585

Interesting Railway Achievements in New Zealand (Illustrated) *W. Wilson* 181

Iron Industries—The Cement and; a Comparative Study (Illustrated) *Edwin C. Eckel* 854

Japanese Empire—Mineral Resources of the (Illustrated) *Dr. A. Selwyn-Brown* 347, 568

Jobbing and Repair Shops—A Simple System for *W. O. Horsnaill* . 868
Junge-Hermsdorf, Dr. Franz Erich Monopoly and Progress 489, 688, 841
Knesche, J. A. Power Required for Rolling Steel (Illustrated) . 41, 223
Knoeppel, C. E. Systematic Foundry Operation and Foundry Costs (Illustrated) 56, 201, 393, 553, 745
Koon, Sidney Graves Dreadnoughts—What Are They? (Illustrated) 521
Krupp Works (Illustrated) 881
Labor in Bituminous Coal Mining—Division of *W. E. Fohl* . . 175
Lift-Valve Engines—European (Illustrated) *Warren H. Miller* . 192
Locomobile or Superheated Steam Unit (Illustrated) *Warren H. Miller* 64
Loeb, Leo The Purchase of Coal by Specifications (Illustrated) . 897
Machine Shops and Industrial Plants—Modern (Illustrated) *Charles Day* 541, 729
Mail-Handling Plant at the New Pennsylvania Terminal (Illustrated) *Joseph B. Baker* 711
Manufacture of Illuminating Gas—Recent Mechanical Improvements in the (Illustrated) *Jacques Boyer* 925
Mechanical Improvements in the Manufacture of Illuminating Gas—Recent (Illustrated) *Jacques Boyer* 925
Mendenhall, J. Accounting and Cost-Keeping System of the United States Navy 910
Miller, Warren H. European Lift-Valve Engines (Illustrated) . 192
Miller, Warren H. The Locomobile or Superheated Steam Unit (Illustrated) 64
Mineral Resources of the Japanese Empire (Illustrated) *Dr. A. Selwyn-Brown* 347, 568
Mining, Bituminous Coal—Division of Labor in *W. E. Fohl* . . 175
Modern Machine Shops and Industrial Plants (Illustrated) *Charles Day* 541, 729
Monopoly and Progress *Dr. Franz Erich Junge-Hermsdorf* 489, 688, 841
Mulford, Wm. W. The Organization of Great Corporations (Illustrated) 240
Municipal Administration—An Influence for Efficiency in (Illustrated) *Herbert T. Wade* 585
Navy—Engineering in the. Its Organization and Efficiency *Ira N. Hollis* 673
Navy, United States—Accounting and Cost-Keeping System of the *J. Mendenhall* 910
New Era in Electrical Illumination (Illustrated) *Rollin W. Hutchinson, Jr.* 365, 507, 698
New Pennsylvania Terminal—Mail-Handling Plant at the (Illustrated) *Joseph B. Baker* 711

New Zealand—Interesting Railway Achievements in (Illustrated) *W. Wilson* 181

Operation—Systematic Foundry, and Foundry Costs (Illustrated) *C. E. Knoeppel* 56, 201, 393, 553, 745

Organization and Efficiency—Engineering in the Navy. Its *Ira N. Hollis* 673

Organization of Great Corporations (Illustrated) *Wm. W. Mulford* 240

"Outsider" and the Busy Business Man *William Perry* . . 249

Panama Canal—Progress in the Construction of the (Illustrated) 389

Panama—Recent Progress at (Illustrated) *Fullerton L. Waldo* . 1

Panama—The Development of, by Public Roads (Illustrated) *Edward Perry* 213

Pennsylvania Terminal—Mail-Handling Plant at the New (Illustrated) *Joseph B. Baker* 711

Perry, Edward The Development of Panama by Public Roads (Illustrated) 213

Perry, William The "Outsider" and the Busy Business Man . 249

Plant—Mail-Handling, at the New Pennsylvania Terminal (Illustrated) *Joseph B. Baker* 711

Plants, Industrial—Modern Machine Shops and (Illustrated) *Charles Day* 541, 729

Powell, Paul R. Cost Keeping in Small Factories (Illustrated) . 31

Power Required for Rolling Steel (Illustrated) *J. A. Knesche* . 41, 223

Prevention—Smoke, and the Efficiency of Firemen. A Concrete Instance (Illustrated) *J. A. Switzer* 83

Prevention, Smoke—The Economy of (Illustrated) *J. A. Switzer* . 406

Principles of Efficiency—The Twelve (Illustrated) *Harrington Emerson* 77, 161, 413, 496, 761, 943

Progress at Panama—Recent (Illustrated) *Fullerton L. Waldo* . 1

Progress in the Construction of the Panama Canal (Illustrated) 389

Progress—Monopoly and *Dr. Franz Erich Junge-Hermsdorf* 489, 688, 841

Public Roads—The Development of Panama by (Illustrated) *Edward Perry* 213

Purchase of Coal by Specifications (Illustrated) *Leo Loeb* . . 897

Railway Achievements in New Zealand—Interesting (Illustrated) *W. Wilson* 181

Railways, Trunk-Line—The Electrification Problem on *A. D. Williams* 757

Recent Mechanical Improvements in the Manufacture of Illuminating Gas (Illustrated) *Jacques Boyer* 925

Recent Progress at Panama (Illustrated) *Fullerton L. Waldo* . 1

Reducing the Costs of Engine Building by Efficiency Methods *Wm. O. Webber* 86

Reinforced-Concrete Boiler Settings *W. H. Weston* . . . 563

Repair Shops—A Simple System for Jobbing and *W. O. Horsnaill* 868

Resources of the Japanese Empire—Mineral (Illustrated) *Dr. A. Selwyn-Brown* 347, 568

Roads, Public—The Development of Panama by (Illustrated) *Edward Perry* 213

Rolling Steel—Power Required for (Illustrated) *J. A. Knesche* 41, 223

Selwyn-Brown, Dr. A. Mineral Resources of the Japanese Empire (Illustrated) 347, 568

Settings, Boiler—Reinforced-Concrete *W. H. Weston* . . 563

Shops, Jobbing and Repair—A Simple System for *W. O. Horsnaill* 868

Shops, Machine, and Industrial Plants—Modern. (Illustrated) *Charles Day* 541, 729

Simple System for Jobbing and Repair Shops *W. H. Horsnaill* . 868

Small Factories—Cost Keeping in (Illustrated) *Paul R. Powell* . 31

Smoke Prevention and the Efficiency of Firemen. A Concrete Instance (Illustrated) *J. A. Switzer* 83

Smoke Prevention—The Economy of (Illustrated) *J. A. Switzer* . 406

Specifications—The Purchase of Coal by (Illustrated) *Leo Loeb* 897

Steam Unit, Superheated—The Locomobile or (Illustrated) *Warren H. Miller* 64

Steel, Rolling—Power Required for (Illustrated) *J. A. Knesche* 41, 223

Superheated Steam Unit—The Locomobile or (Illustrated) *Warren H. Miller* 64

Switzer, J. A. Smoke Prevention and the Efficiency of Firemen. A Concrete Instance (Illustrated) 83

Switzer, J. A. The Economy of Smoke Prevention (Illustrated) . 406

System—Accounting and Cost-Keeping, of the United States Navy *J. Mendenhall* 910

Systematic Foundry Operation and Foundry Costs (Illustrated) *C. E. Knoeppel* 56, 201, 393, 553, 745

System for Jobbing and Repair Shops—A Simple *W. O. Horsnaill* 868

Terminal, the New Pennsylvania—Mail-Handling Plant at (Illustrated) *Joseph B. Baker* 711

Trunk-Line Railways—The Electrification Problem on *A. D. Williams* 757

Twelve Principles of Efficiency (Illustrated) *Harrington Emerson* 77, 161, 413, 496, 761, 943

United States Navy—Accounting and Cost-Keeping System of the *J. Mendenhall* 910

Unit, Superheated Steam—The Locomobile or (Illustrated) *Warren H. Miller* 64

Ventilation Factory—The Economics of *Royce W. Gilbert* . 339

Wade, Herbert T. AN INFLUENCE FOR EFFICIENCY IN MUNICIPAL ADMINISTRATION (Illustrated) 585
Waldo, Fullerton L. RECENT PROGRESS AT PANAMA (Illustrated) . 1
Webber, Wm. O. REDUCING THE COSTS OF ENGINE BUILDING BY EFFICIENCY METHODS 86
Weston, W. H. REINFORCED-CONCRETE BOILER SETTINGS . . . 563
William, A. D. THE ELECTRIFICATION PROBLEM ON TRUNK-LINE RAILWAYS 757
Wilson, W. INTERESTING RAILWAY ACHIEVEMENTS IN NEW ZEALAND (Illustrated) 181
WORKS—THE KRUPP (Illustrated) 881

REVIEWS, INDEX, AND EDITORIALS.

Accidents, Industrial—The Prevention of 969
Acid Manufacture, Sulphuric—Pyrite Smelting and 282
Alloys—Magnetic, from Non-Magnetic Materials 613
Armament of Battleships 625
Assay of Water—The Field 99
Barometric Pressure and Liberation of Firedamp 443
Battleships—The Armament of 625
Boiler Furnaces—The Clinkering of Coal in 771
Brass—The Heat Treatment of 278
Bridge, Quebec—The Reconstruction of the 275
Briquetting of Iron Ores 262
Building of the New Canadian Navy 785
Canada—Peat Investigations in 109
Canadian Navy—The Building of the New 785
Car Meters—The Control of Motormen by 448
Castings to Withstand High Pressures 972
Chambers—Refuge, in Coal Mines 105
Civil Engineering, Engineering Index 119, 285, 451, 631, 795, 977
Civil Engineers—The Licensing of 956
Clinkering of Coal in Boiler Furnaces. 771
Coal Dust Explosions—The Prevention of 627
Coal Mines—Refuge Chambers in 105
Coal—The Clinkering of, in Boiler Furnaces 771
Coke in Foundry Practice 787
Collisions—Railway, in the United States 974
Compressors—Humphrey Pumps and. 607
Condensation, Surface—Transmission of Heat in 620
Condensers, Jet and Surface—The Fields for 965
Condensers, Surface—Water Velocity in 435
Consumption—Power, of Steam and Electric Hoists 267
Control of Motormen by Car Meters 448
Conveyors, Belt—Steel 104
Cyanide Process—A Modification of the 446
Cylinders, Gas Engine—Failures of 111
Danger Signals—The Over-Running of 789
Determination of Stresses—The Optical 953
Disposal of Trade Wastes 777
Dust Explosions, Coal—The Prevention of 627
Economics of Railway Electrification 113
Editorial Comment. 91, 257, 425, 605, 769, 951
Electrical Engineering, Engineering Index 126, 294, 458, 639, 804, 987
Electric Hoists—Power Consumption of Steam and 267
Electrification, Railway—The Economics of 113
Electrolytic Oil Separator 792
Electro-Magnetic Transmission for Marine Turbines 265
Engineering Index, 119, 285, 451, 631, 795, 977
Engineers, Civil—The Licensing of 956
Engineers, Young—The Training of 616
European Locomotives for Very High Speeds 116
Explosions, Coal Dust—The Prevention of 627
Explosions, Gaseous—Radiation from. 259
Extermination, Mosquito — Modern Methods of 96
Failures of Gas Engine Cylinders 111
Field Assay of Water 99
Field for Grinding 618
Fields for Jet and Surface Condensers 965
Files—The Testing of 270
Firedamp, Liberation of—Barometric Pressure and 443
Foundry Practice—Coke in 787
French Railway Strike 430
Frozen Season—Stream Gauging During the 961
Furnaces, Boiler—The Clinkering of Coal in 771
Gas Engine Cylinders—Failures of 111
Gaseous Explosions—Radiation from 259
Gauging—Stream, During the Frozen Season 961
Germany—The Steam Turbine in 439
Grinding Practice—Modern 779
Grinding—The Field for 618
Growth of Steamships 432

Heat—Transmission of, in Surface Condensation 620
Heat Treatment of Brass............ 278
High Pressures—Castings to Withstand 972
High-Speed Steel—Machine Tools for. 93
High Speeds, Very—European Locomotives for.......................... 116
Hoists, Steam and Electric—Power Consumption of.................... 267
Humphrey Pumps and Compressors... 607
Index—The Engineering, 119, 285, 451, 631, 795, 977
Industrial Accidents—The Prevention of 969
Industrial Economy, Engineering Index..........131, 299, 463, 645, 810, 992
Inventions, Process—The Philosophy of 441
Iron Ore Resources of the World..... 102
Iron Ores—The Briquetting of........ 262
Jet and Surface Condensers—The Fields for 965
Liberation of Firedamp—Barometric Pressure and...................... 443
Licensing of Civil Engineers..........
Lighting—Street, with Tungsten Lamps 611
Locomotives for Very High Speeds—European 116
Machine Tools for High-Speed Steel.. 93
Magnetic Alloys from Non-Magnetic Materials 613
"Maine"—The Plan for Raising the Wreck of the...................... 782
Management, Railroad—Scientific..... 622
Manufacture, Sulphuric Acid—Pyrite Smelting and...................... 282
Marine and Naval Engineering, Engineering Index..133, 300, 464, 646, 812, 993
Marine Turbines—An Electro-Magnetic Transmission for................ 265
Materials, Non-Magnetic — Magnetic Alloys from....................... 613
Mechanical Engineering, Engineering Index........134, 302, 465, 647, 814, 995
Meters, Car—The Control of Motormen by.............................. 448
Methods of Mosquito Extermination—Modern 96
Mines, Coal—Refuge Chambers in.... 105
Mining and Metallurgy, Engineering Index........146, 314, 475, 659, 826, 1008
Modern Grinding Practice............ 779
Modern Methods of Mosquito Extermination 96
Modification of the Cyanide Process... 446
Mosquito Extermination — Modern Methods of.. 96
Motormen—The Control of, by Car Meters 448
Motors, Steelworks—Speed Regulation of 272
Navy—The Building of the New Canadian 785
Non-Magnetic Materials—Magnetic Alloys from......................... 613
Ocean-Going Oil-Engine Ship........ 963
Oil-Engine Ship—An Ocean-Going... 963
Oil Separator—An Electrolytic........ 792
Optical Determination of Stresses.... 953
Ore Resources of the World—The Iron 102
Ores, Iron—The Briquetting of....... 262
Over-Running of Danger Signals...... 789
Paint Vehicles—A Study of.......... 958
Panama—A Year's Progress at....... 427
Peat Investigations in Canada........ 109
Philosophy of Process Inventions..... 441
Plan for Raising the Wreck of the "Maine" 782
Power Consumption of Steam and Electric Hoists...................... 267
Practice, Foundry—Coke in........... 787
Practice—Modern Grinding........... 779
Pressure—Barometric, and Liberation of Firedamp........................ 443
Pressures, High—Castings to Withstand 972
Prevention of Coal Dust Explosions.. 627
Prevention of Industrial Accidents.... 969
Process, Cyanide—A Modification of the 446
Process Inventions—The Philosophy of 441
Pumps and Compressors—Humphrey. 607
Pyrite Smelting and Sulphuric Acid Manufacture 282
Quebec Bridge—The Reconstruction of the.... 275
Radiation from Gaseous Explosions.. 259
Railroad Management—Scientific..... 622
Railway Collisions in the United States 974
Railway Electrification—The Economics of.......................... 113
Railway Engineering, Engineering Index.........154, 321, 482, 666, 834, 1017
Railway Strike—The French.......... 430
Raising the Wreck of the "Maine"—The Plan for...................... 782
Rays, Ultra-Violet—Sterilization of Water by......................... 280
Reconstruction of the Quebec Bridge.. 275
Refuge Chambers in Coal Mines..... 105

Regulation of Steelworks Motors—Speed ... 272
Resources—The Iron Ore, of the World ... 102
Scientific Railroad Management ... 622
Season, Frozen—Stream Gauging During the ... 961
Separator, Oil—An Electrolytic ... 792
Ship—An Ocean-Going Oil-Engine ... 963
Signals, Danger—The Over-Running of ... 789
Smelting—Pyrite, and Sulphuric Acid Manufacture ... 282
Speed Regulation of Steelworks Motors ... 272
Speeds, Very High—European Locomotives for ... 116
Steam and Electric Hoists—Power Consumption of ... 267
Steamships—The Growth of ... 432
Steam Turbine in Germany ... 439
Steam Turbines and Turbo-Generators—The Testing of ... 774
Steel Belt Conveyors ... 104
Steel, High-Speed—Machine Tools for 93
Steelworks Motors—Speed Regulation of ... 272
Sterilization of Water by Ultra-Violet Rays ... 280
Stream Gauging During the Frozen Season ... 961
Street and Electric Railways, Engineering Index 157, 324, 485, 669, 837, 1020
Street Lighting with Tungsten Lamps. 611
Stresses—The Optical Determination of 953
Strike—The French Railway ... 430
Study of Paint Vehicles ... 958
Sulphuric Acid Manufacture—Pyrite Smelting and ... 282
Surface Condensation—Transmission of Heat in ... 620
Surface Condensers, Jet and—The Fields for ... 965
Surface Condensers—Water Velocity in ... 435
Testing of Files ... 270
Testing of Steam Turbines and Turbo-Generators ... 774
Tools for High-Speed Steel—Machine. 93
Trade Wastes—The Disposal of ... 777
Training of Young Engineers ... 616
Transmission for Marine Turbines—An Electro-Magnetic ... 265
Transmission of Heat in Surface Condensation ... 620
Treatment of Brass—The Heat ... 278
Tungsten Lamps—Street Lighting with 611
Turbines and Turbo-Generators, Steam—The Testing of ... 774
Turbines, Marine—An Electro-Magnetic Transmission for ... 265
Turbine—The Steam in Germany ... 439
Turbo-Generators, Steam Turbines and—The Testing of ... 774
Ultra-Violet Rays—Sterilization of Water by ... 280
United States—Railway Collisions in the ... 974
Vehicles, Paint—A Study of ... 958
Velocity—Water, in Surface Condensers ... 435
Wastes, Trade—The Disposal of ... 777
Water—Sterilization of, by Ultra-Violet Rays ... 280
Water—The Field Assay of ... 99
Water Velocity in Surface Condensers. 435
World—The Iron Ore Resources of the ... 102
Wreck of the "Maine"—The Plan for Raising the ... 782
Year's Progress at Panama ... 427
Young Engineers—The Training of ... 616

THE ENGINEERING MAGAZINE
"THE WORLD IS ITS FIELD"

VOL. XL. OCTOBER, 1910. No. 1.

RECENT PROGRESS AT PANAMA.

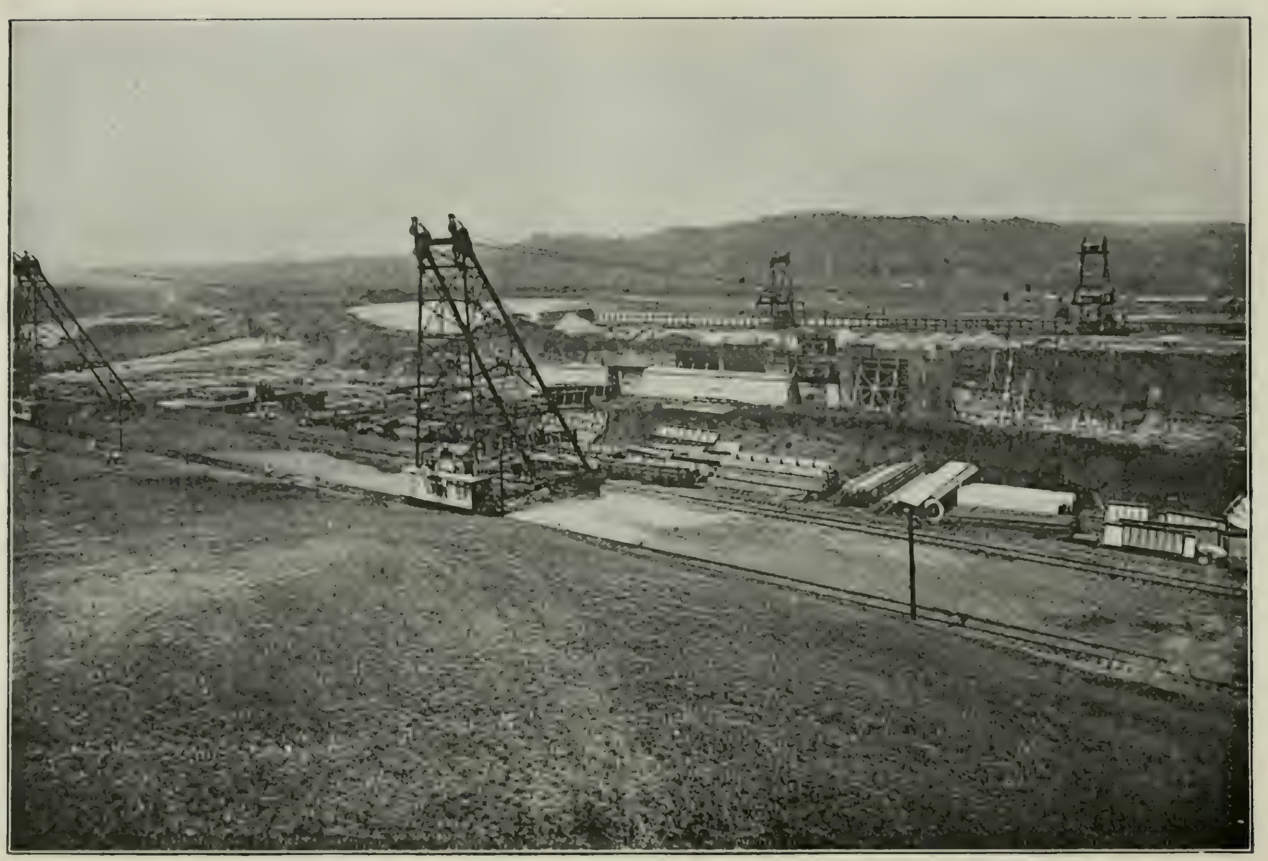
By Fullerton L. Waldo, F. R. G. S.

Mr. Waldo's report of personal observations lately made on the Isthmus is welcomed because it expresses the verdict of a normal, healthy, well-informed and open mind free from commitment to any special or pre-conceived opinions. It is of further interest because it affords comparison with a preceding examination made under closely similar circumstances three years ago. For the accompanying views we are indebted to the courtesy of the Isthmian Canal Commission, through Capt. F. C. Boggs, Corps of Engineers, U. S. Army, Chief of Office.—THE EDITORS.

THE rapid progress that has been made in the last few months at Panama can scarcely be comprehended from the perusal of the statistics and the sober digest appearing from week to week in the Canal Record. I was on the Isthmus in January, 1907, and my impressions of the work as it then was appeared in the following month's issue of THE ENGINEERING MAGAZINE. Having just returned from the Isthmus, where I spent the last week in July, I am moved to institute a comparison—which should not prove odious—with conditions in 1907.

At the time of my previous visit the army administration was about to take hold of the work. Wallace and Stevens rendered splendid service and will be honorably remembered. The work they did made possible the work that is going on now. Long after acrimonious discussion is forgotten, the positive achievement of a man counts in his favor; and so it will prove in the case of the two great civilian chief engineers.

The men of the army, in the soldierly spirit of mute obedience, have continued to "make good." Colonel Goethals daily builds his imperishable monument; Colonel Gorgas, by showing white men how

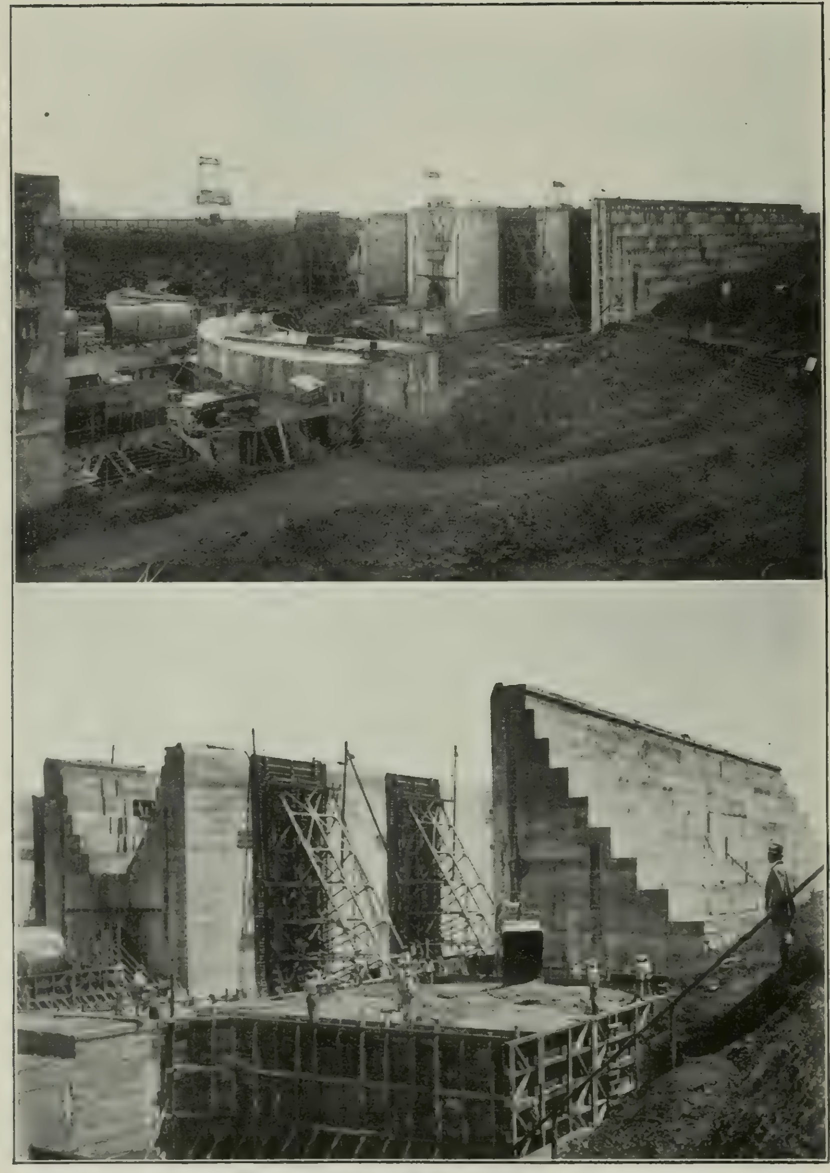


GENERAL VIEW OF GATUN LOCK CABLEWAYS, SHOWING THE DAM SITE IN THE BACKGROUND.

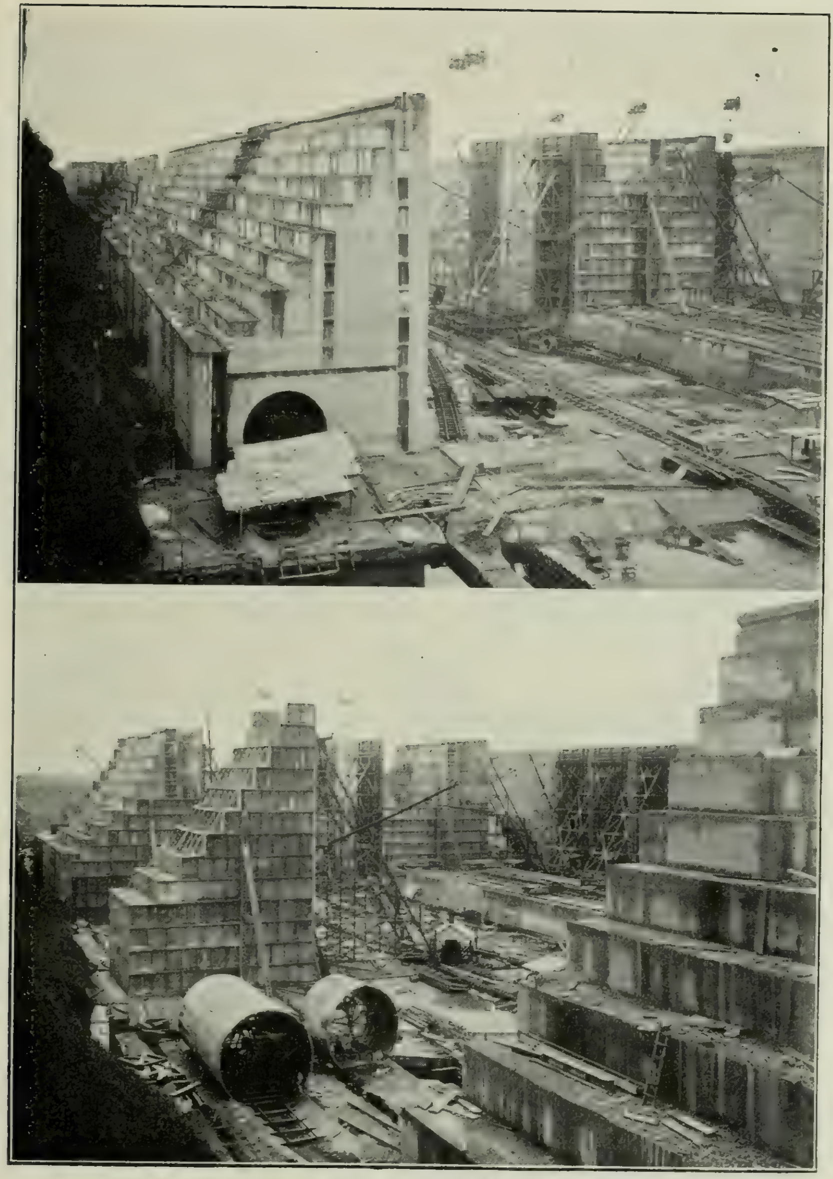
they can live in the tropics, has placed humanity for all time deeply in his debt. It is not too much to say there would have been no near probability—much less the confident assurance—of a canal if Gorgas had not expurgated yellow fever along with the *stegomyia,* and minimized the malarial burden of *anopheles.* But panegyric is apart from the purpose of the present article, the aim of which is merely to contrast what there was "to show for the money" three years ago, and what exists today as a refutation of the scepticism of those who opposed the Isthmian waterway—a carping band of obstructionists and pull-backs now mostly shamed into silence.

In January, 1907, there was one lonely little steam shovel courageously butting into the hillside at Gatun, making a beginning of the excavation for the locks. Down below, a steam launch drowsed on the stagnant strip of water that represented what was left of the shallow channel dug for seven miles from the sea at Colon by the French. There was a palm-thatched native village, and a wooden gray Catholic church thrust its spire a little above the tallest fronds of the cocoanut-palms. The chocolate-brown Chagres swirled insolently down the middle of the wide green valley and otherwise there was scarcely a break in the ample expanse of greenery from hill to hill. They showed us blueprints of 580 borings taken to prove that a vast earth-barrow half a mile thick and a mile and a half long, could without percolation blot out the village, bar the river and form a lake reaching for 24 miles to the backbone of the continental divide at Culebra. We believed what they told us; but there were a great many untechnical, average people here at home who asked doubtfully of everyone who came from the Isthmus in those days, "Do you really believe they are going to be able to put the canal through?" For the obsession of the French failure still weighed heavily on the minds of many doubting Thomases, and the optimistic prophecies of the toilers on the spot seemed too good to be true.

We ran all over the premises at Gatun, in the division engineer's track-automobile; we climbed into and around the huge lock-chambers, breathed the choking dust of the concrete-mixers, and risked the third-rail system animated by the magnificent new power-house. It was hard to believe it was the same place as the site of the furtive operations of the single shovel in 1907. The indignant Chagres, uncurbed since the first Spanish occupation, now rioted seaward through a 300-foot spillway channeled through a mound in the middle of the dam-site. Already the Gatun Lake has become a very considerable sheet of water, dotted here and there with a surviving clump of trees



GATUN UPPER LOCKS.
Above, the lift sill and forebay from the east bank. Below, constructing monoliths of concrete. Views taken about the first of June, 1910.

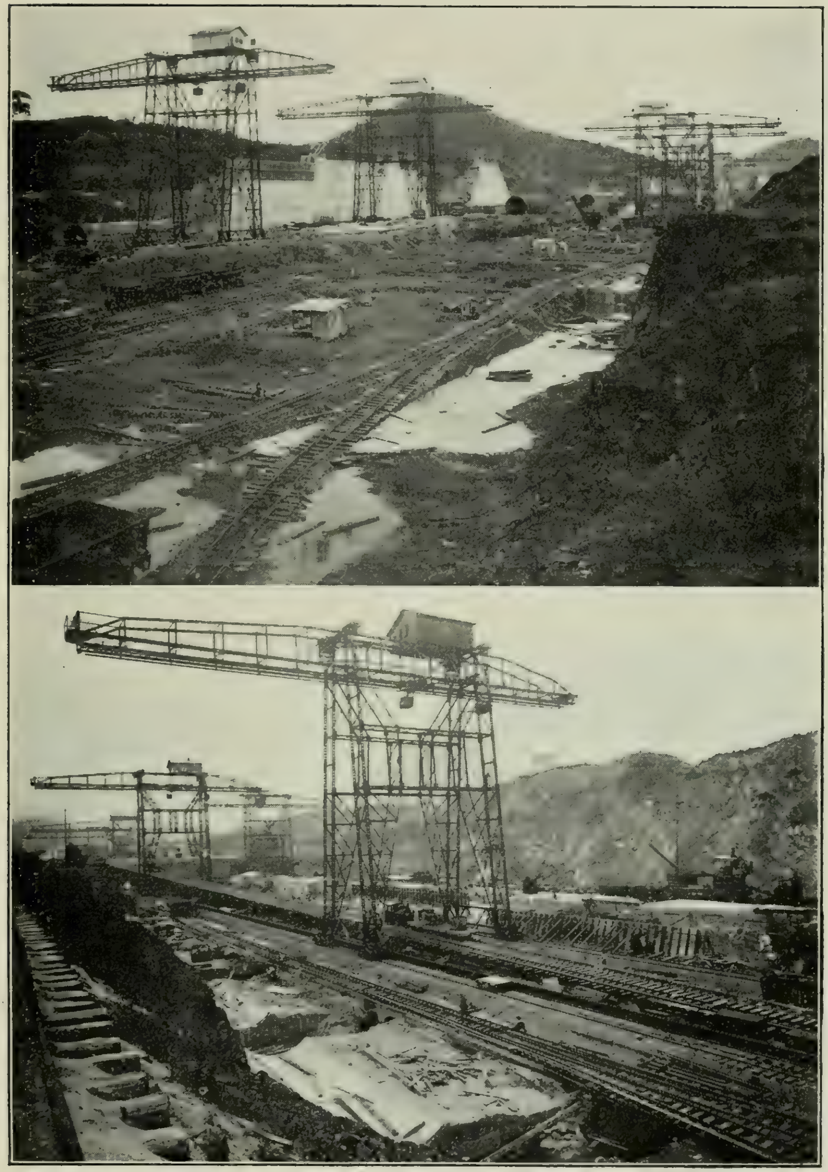


GATUN UPPER LOCKS.
Above, looking south from the east bank, July 2, 1910. Below, looking north from the west bank at the same date.

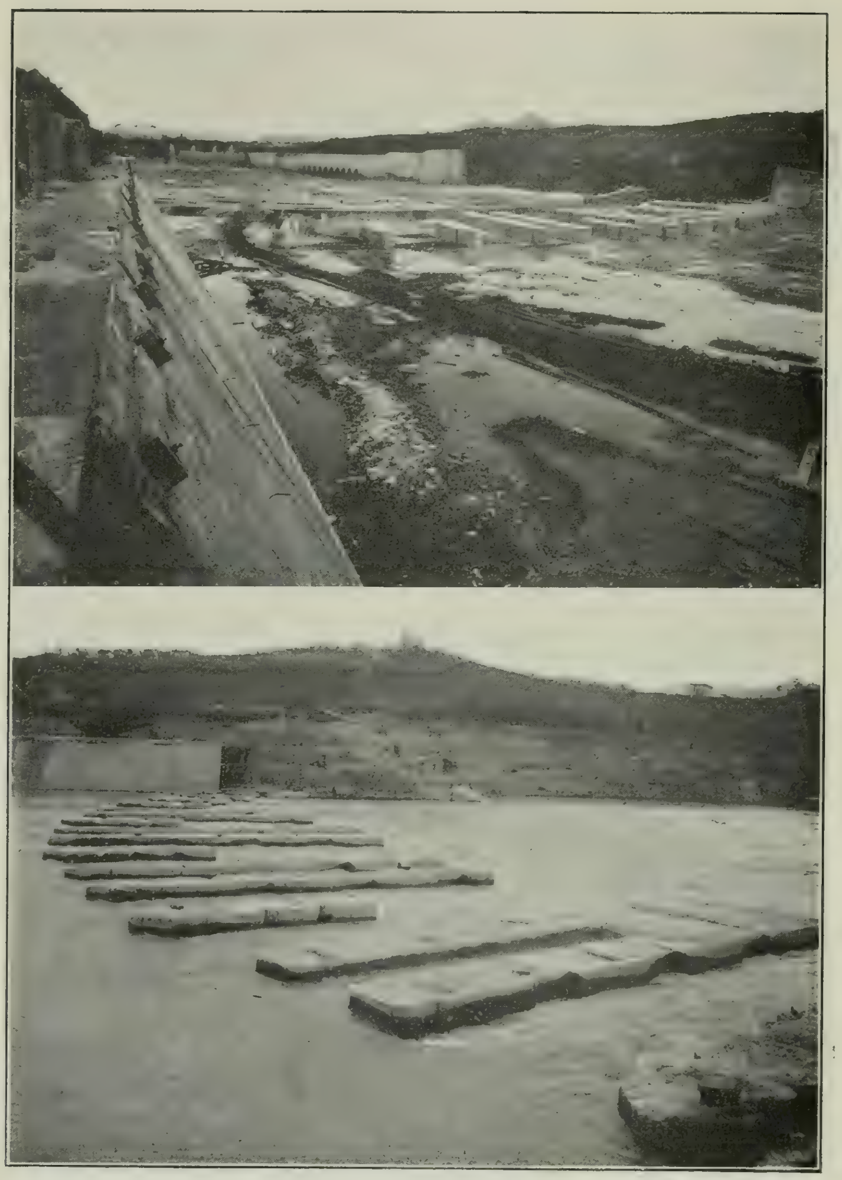
or an abandoned roof, and requiring the constant presence of one of the big dredges with living-quarters as comfortable as those of a houseboat. The great, terraced lock-walls instantly challenged comparison with the work of the builders of the mausoleum of Cheops. You could hardly understand how much concrete goes into these "monoliths" as they are called, till you saw the barrels and bags stored in the sheds. On July 26 the Ancon arriving at Cristobal unloaded 33,000 barrels and 80,000 bags of cement, and was away again in 24 hours, and nobody made the slightest fuss about it. In one day last June, Colonel Sibert told me, they put down 3,998 cubic yards of cement on the lock site, and in the working days of the month were laid a total of no less than 89,000 cubic yards. The masonry work for the first pair of locks will assuredly be completed by November. The floor of the second pair of locks is already prepared to receive the superstructure. The shovels are now grubbing 40 feet below sea-level to complete the necessary excavation for the third pair of locks—and this, it is expected, will be done by January.

We were shown in the central offices at Culebra a most interesting model of a typical completed lock with a small wooden replica of the Olympic going through it. The Olympic is one of the new Titans of the White Star Line, 890 feet in length and 92 feet wide; and she will have plenty of leeway in a chamber whose usable dimensions are 1,000 by 110 feet. The Olympic, with her 60,000 gross and 45,000 net tonnage represents the largest type of vessel that can seek to cross the Isthmus for a long time to come, and there is still a margin left for ships even more monstrous. The lock-model clearly illustrates the action of safety-gates in checking the flow of water; and a chain from wall to wall in front of the lock chamber, in an emergency, will suddenly restrain a vessel of 10,000 tons moving at 6 miles an hour. The further precaution will be taken to forbid vessels from proceeding under their own steam; they are to be taken in tow by electric locomotives.

It is scarcely necessary to recapitulate the dimensions of the great lock-works and the huge dam that is steadily rising at Gatun. Briefly, the three lock flights divide the vertical distance to the 85-foot level between them, whereas the locks of the Pacific division—the pair at Pedro Miguel and the two combined pairs at Miraflores—have lifts of 33 1-3 feet and 54 2-3 feet, respectively. The dam itself is to be a mile and a half long, 100 feet wide at the top, and 400 feet in thickness at the water line. The crest will be 115 feet above the sea-level—hence 30 feet higher than the general surface of Lake Gatun.



PEDRO MIGUEL LOCKS.
Above, a view northward from the east bank, June 13, 1910. Below, a view looking north from the west bank, taken two months earlier.



THE GATUN SPILLWAY.
Above, a view looking north from the west wall. Foundations for valve and cofferdam piers in the foreground. Below, the southern end of the spillway looking west from the east wall.

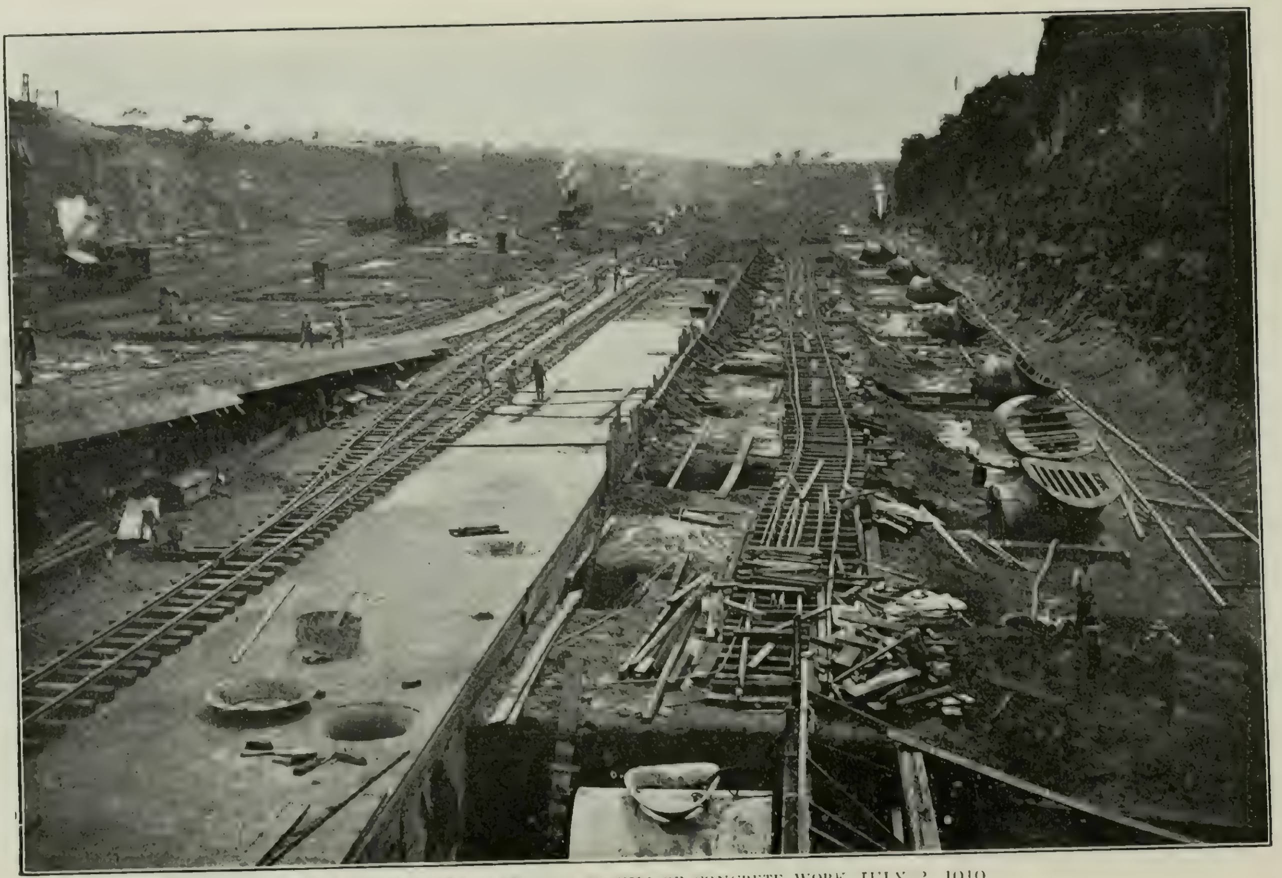
The spillway is 1,200 feet in length and there will be an ingenious regulating system installed to maintain the lake, with its area of about 164 square miles, at the desired level.

An illustration of the rate at which the hydraulic dredges are now working at Gatun is an episode that occurred a few hours before our visit. One of the sturdy Gallegos Spaniards, who bear the brunt of the more exacting labor, was sucked into the voracious opening of a 16-inch pipe line. Two fellow workmen grabbed him, but he was torn from their hands. In 60 seconds he was carried 265 feet and poured out, gurgling and gasping, on the river's bank. Within a few hours he was back at work again, none the worse for his jarring experience.

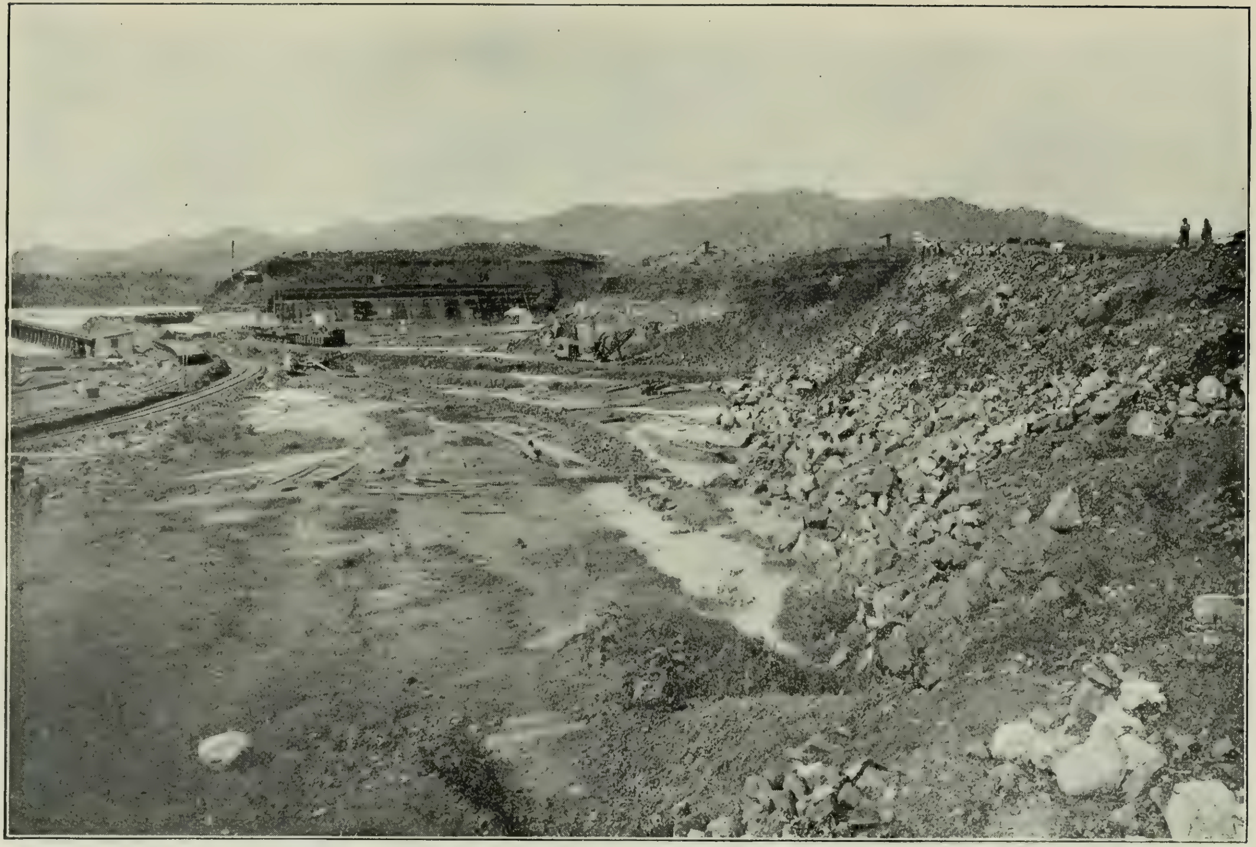
It is calculated that the boats ascending the lock-stair at Gatun will not require more than 1½ hours for the transit; and the Pacific locks will detain the vessels for about the same length of time. The average vessel will take from 10 to 12 hours to cross the Isthmus, and there is no reason why passengers should not proceed by train, if they like, in advance of the ships, and disport themselves as they please at either terminus. The train takes 2½ hours for the passage.

Under ordinary circumstances it will require about 15 minutes to fill the lock-chamber; if there is particular need for haste, the process can be completed in half the time. The available water-supply will allow of 48 lockages per diem—which might easily mean an average of something like 80,000,000 tons of traffic annually, as compared with 21,000,000 tons in the case of the Suez canal and the 40,000,000 tons of the Sault Ste. Marie. The lock-chambers are filled and emptied by means of an interesting system of lateral culverts, which open in the floors and connect with larger culverts in the central and side walls of the lock chamber.

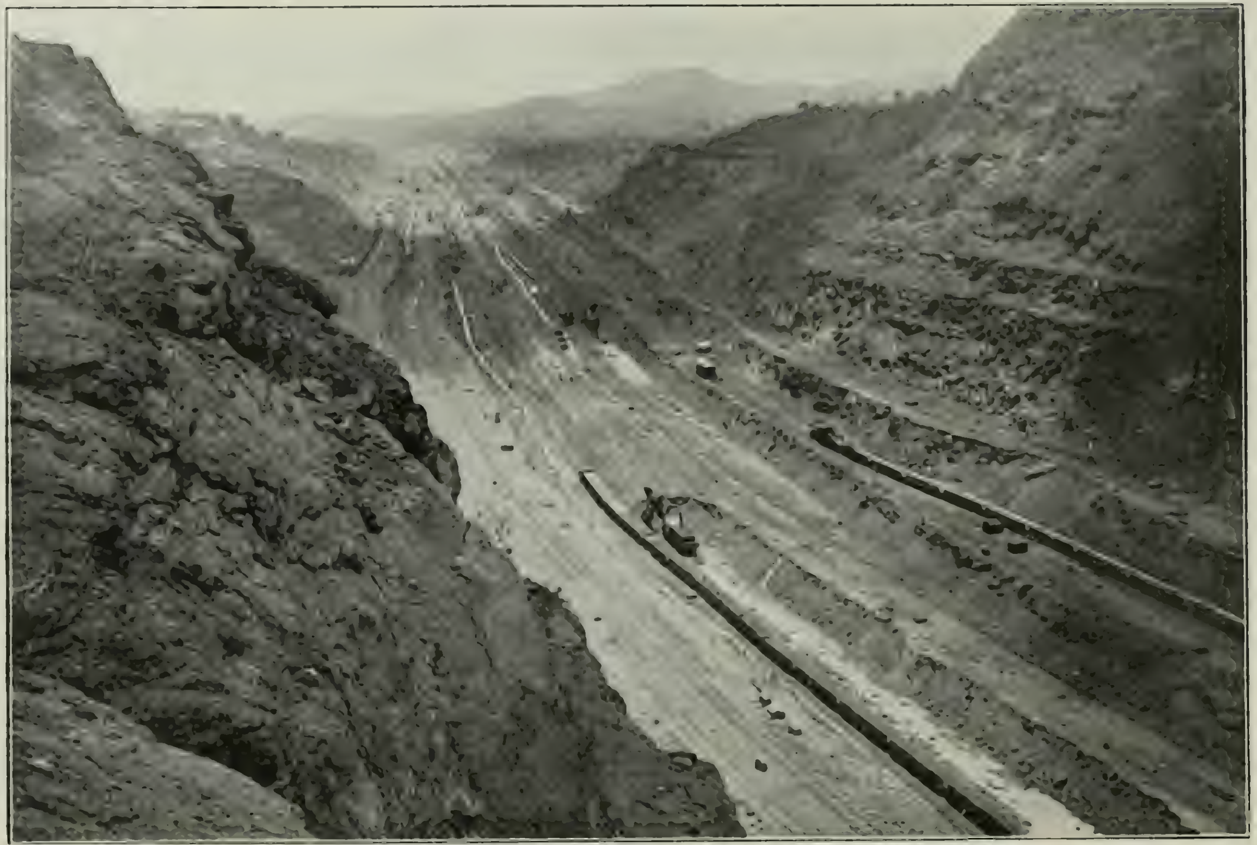
It has, of course, been found necessary to relocate the railroad to bring it around the artificial lake. That is why they have not entirely completed the double-tracking of the present line. From Gatun, the relocated railway will swing some 4½ miles to the eastward of the present right of way, will then traverse the valley of the Chagres, crossing the river by means of a steel bridge ¼ of a mile in length, and will finally come back to the canal at the point where the lake narrows into the excavation in the rock at Bas Obispo, the beginning of the Culebra Cut. The railway at its highest will be 25 feet above the surface of the water. Through the Culebra Cut it will run along on the berm only 10 feet above the canal. From the Pacific side of



GATUN MIDDLE LOCKS, SHOWING STATUS OF CONCRETE WORK JULY 2, 1910.



GATUN SPILLWAY, FROM THE SOUTH TOE OF THE DAM.



THE CULEBRA CUT, FROM CONTRACTOR'S HILL, LOOKING NORTH, APRIL 20, 1910 the cut (at Paraiso) it will parallel the canal to the shore—branching, of course, to the depot at Panama. Near Miraflores there is to be a tunnel 736 feet long. The complete line will be 46.2 miles in length—shorter by a mile than the present route.

Besides the Gatun Dam with the locks, the other great factor upon which the completion of the canal by 1915 depends, is of course the Culebra Cut. A great deal of nonsense has appeared in print in the United States about the Cucaracha and other slides. Reference to the 1909 Report of the Canal Commission will show that the engineers anticipated slides to the extent of about 4,000,000 cubic yards in the Central Division. They have now generously enlarged their estimate to 7,000,000. Suppose the completion of the canal should be delayed two months by these untoward happenings—what is two months, when mankind has waited for four centuries? Standing on the wooden suspension-bridge thrown across the Cut at Empire, one finds it hard to believe that the excavation of such staggering dimensions is the work of man aided by his own "mechanical extension of his powers." It seems as though it must be the work of convulsive natural forces. If Nature here and there shows herself stubbornly opposed to the invasion of drill and shovel, the greater the eventual triumph of man over Nature. One of the slides occurred the night before we came to Culebra, and the next day we saw a shovel, with dirt-trains in assiduous attendance, eating out the heart of it. It was a big slide, a slide that worried the heads of the work, and yet no layman could have seen what there was to make such a fuss about. To read some of the saffron-tinted journals, a "constant reader" 2,000 miles from the spot would be almost sure to believe that the walls of the Cut from top to bottom were caving in. On the spot, there seems to be practically nothing the matter. Moreover, if at the usual angle the earth refuses to stand still, there is no reason why the surface should not be given an outer integument of rock; and in due time the intertangled roots of tropic plants and trees luxuriantly growing will themselves form a sufficient natural protection. Meanwhile, a few of the older houses will have to be moved back from the brink—but what of that? Some of them must be shifted anyway, because the Americans have planned more liberal dimensions than those contemplated thirty years ago by the French engineers.

The official statement of the canal excavation to August 1, 1910, including the allowance for the slides at Culebra, shows 113,135,206 cubic yards excavated since May 4, 1904, when the Americans began work, and 69,402,560 cubic yards remaining to be taken out. Although, to be sure, the excavation of July of the present year amounted to but 2,406,288 cubic yards, this was in the middle of the rainy season, and about twice as much per month can be accomplished in the "dry" months of mid-winter.

The best assurance of the completion of the canal at the time assigned is, after all, not the official report from month to month of the cubic yardage of the shovels, in their intense rivalry judiciously encouraged by the administration. The most convincing exhibit at Panama is the character of the working population itself. There were good men on the Isthmus in 1907, plenty of them, with "their souls in the work of their hands" and the useful knowledge of the schools in their heads, plus the fruition of valuable experience elsewhere. But in 1910 the laborers in all particulars worthy of their hire are excessively in the majority, where formerly they were merely numerous. They have brought their families to the Isthmus, secure in the knowledge of healthful surroundings, good schools, a generally moral environment, social diversions and a thoroughly satisfactory commissariat. The number of gardens, in three years, has increased greatly. The people really seem to care to make their door-yards beautiful. Panama begins to appear like home to them. They are not merely biding their time, in durance vile, until the six-weeks' annual vacation. Every kind of fraternal organization that flourishes in the United States has taken firm root upon the Isthmus. The baseball rivalry is as fast and furious as that of the steam shovels. There is a splendid opera-house in the City of Panama, opened in November, 1908, with a brilliant performance of "Aida." Whereas there were but two automobiles three years ago, the passing of the "benzine buggy" today arouses no comment. The millions of vitrified brick have made Panama by all odds the best-paved city between the capital of Mexico and Buenos Ayres. The railroad that is building westward to David, in the province of Chiriqui near the frontier of Costa Rica, will be an important link in the Pan American Railway that is as sure to come as the Cape-to-Cairo Railway; and when this great international highway is completed it will be possible to go by rail from New York to Panama in something like the time the steamships now require—though the distance overland is 2½ times as great. In the meantime there is no room for any but an optimistic opinion in the mind of every American as to the present and the future of the Panama Canal.

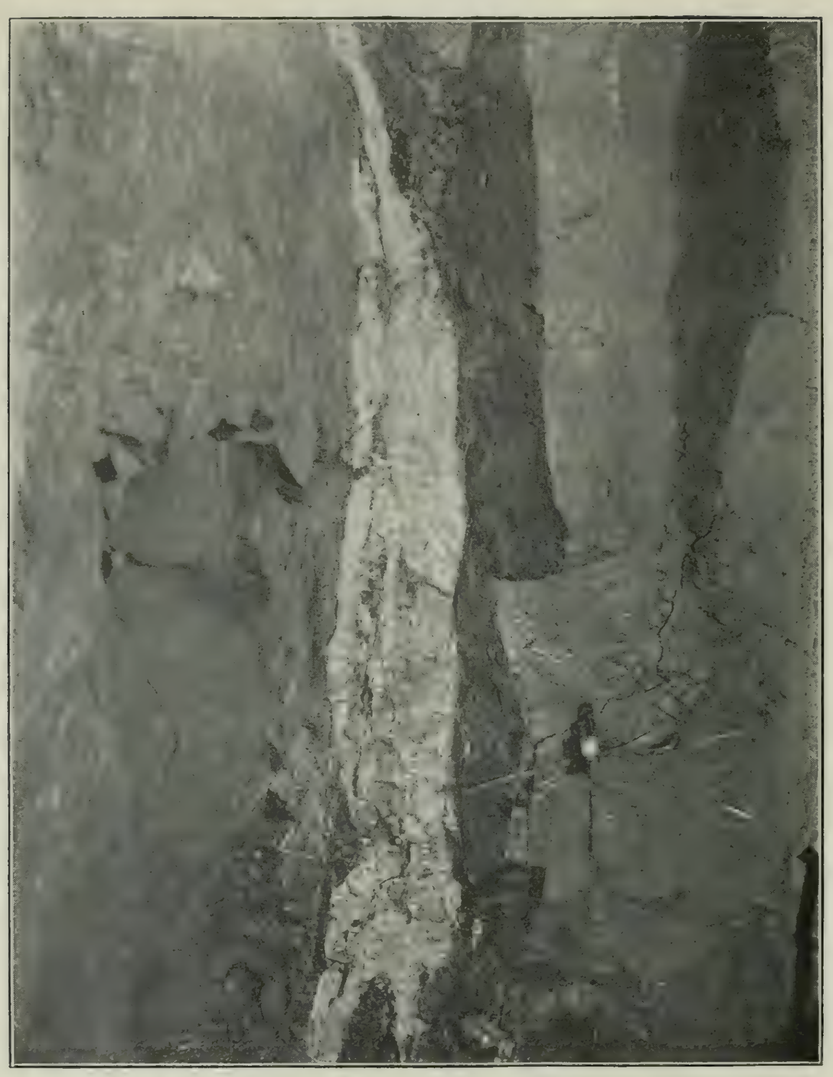
COBALT IN 1910.

By Arthur A. Cole.

Mr. Cole's article is a clean-cut, authoritative and original review of one of the most interesting camps of the day. It gives, in admirably concise form, most useful knowledge of the geological, mining, and economic conditions and of the prospects of the region. The underground photographs, specially taken and copyrighted by the author, are particularly interesting. All rights reserved.—THE EDITORS.

DURING the summer of 1895 the writer had the pleasure of working in the District of Nipissing, Northern Ontario, as assistant to Dr. A. E. Barlow, then one of the field geologists of the Canadian Geological Survey. At that time the district was unmapped excepting Lake Temiskaming and the Montreal River. The rest of the country was practically unknown, except to the Indians and the Hudson's Bay Company. The country was thickly wooded, so that in order to obtain even the barest outline of the geology of the area it was necessary to depend mostly on the natural exposures along the banks of the rivers and the shores of the lakes. Asked as to the mining possibilities of the country, Dr. Barlow stated that, judging from the large areas of diabase that were being encountered, comparable to the nickel-bearing norite masses of Sudbury, he had every expectation that the country would produce valuable mineral deposits, but just what they were likely to be it would be impossible to predict. A little cobalt bloom was found at the time of that survey on Rabbit Lake, near Temagami, but no silver. It was not until eight years later, in the fall of 1903, that La Rose, a blacksmith working on the construction of the Temiskaming & Northern Ontario Railway, made his historic discovery of native silver in the now famous La Rose property in Cobalt.

From the first the officers of the Bureau of Mines, Toronto, realized the importance of the find and the new camp was given constant and most valuable assistance by the Bureau. Geological maps of remarkable accuracy, considering the difficulties under which they were compiled, were early issued and these were of immense benefit to the prospectors. The report of Dr. W. G. Miller, Provincial Geologist,

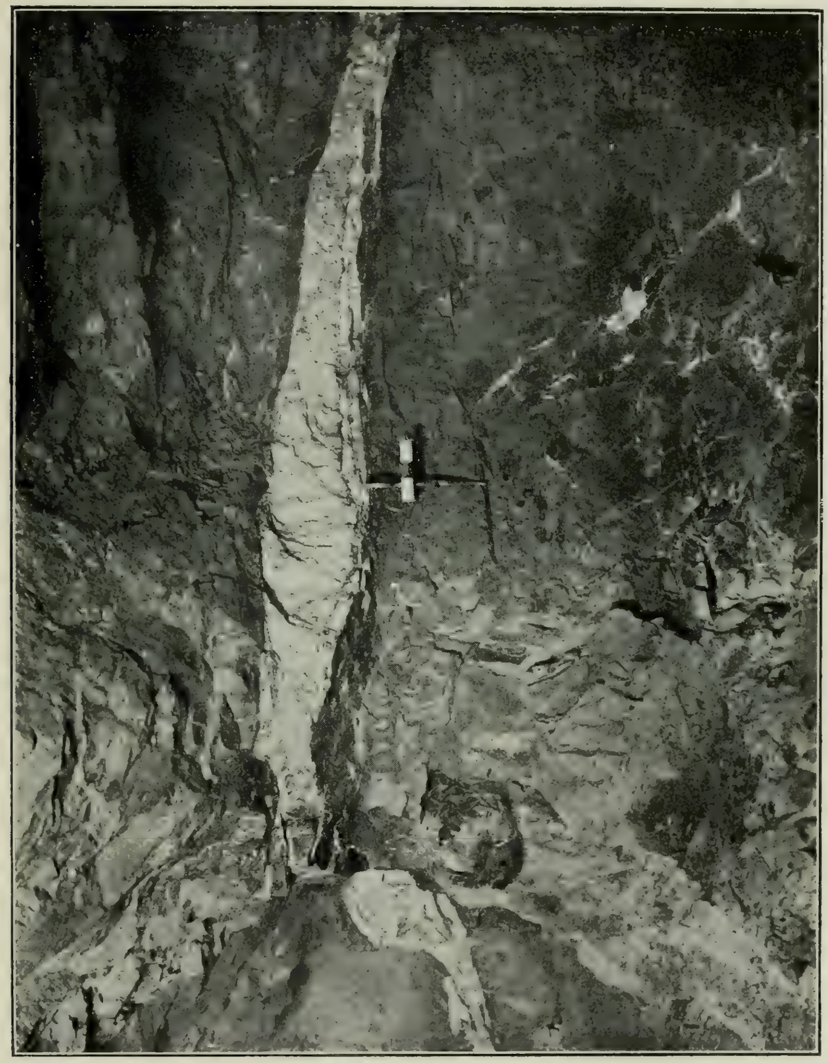


SILVER VEIN IN CROWN RESERVE MINE, NEAR COBALT. MAXIMUM WIDTH 6 INCHES 200 FOOT LEVEL, IN HURONIAN FORMATION.
Copyright, 1910, by A. A. Cole.

and his able assistants is now a classic and still holds its place as one of the leading books of reference on the Cobalt Camp.

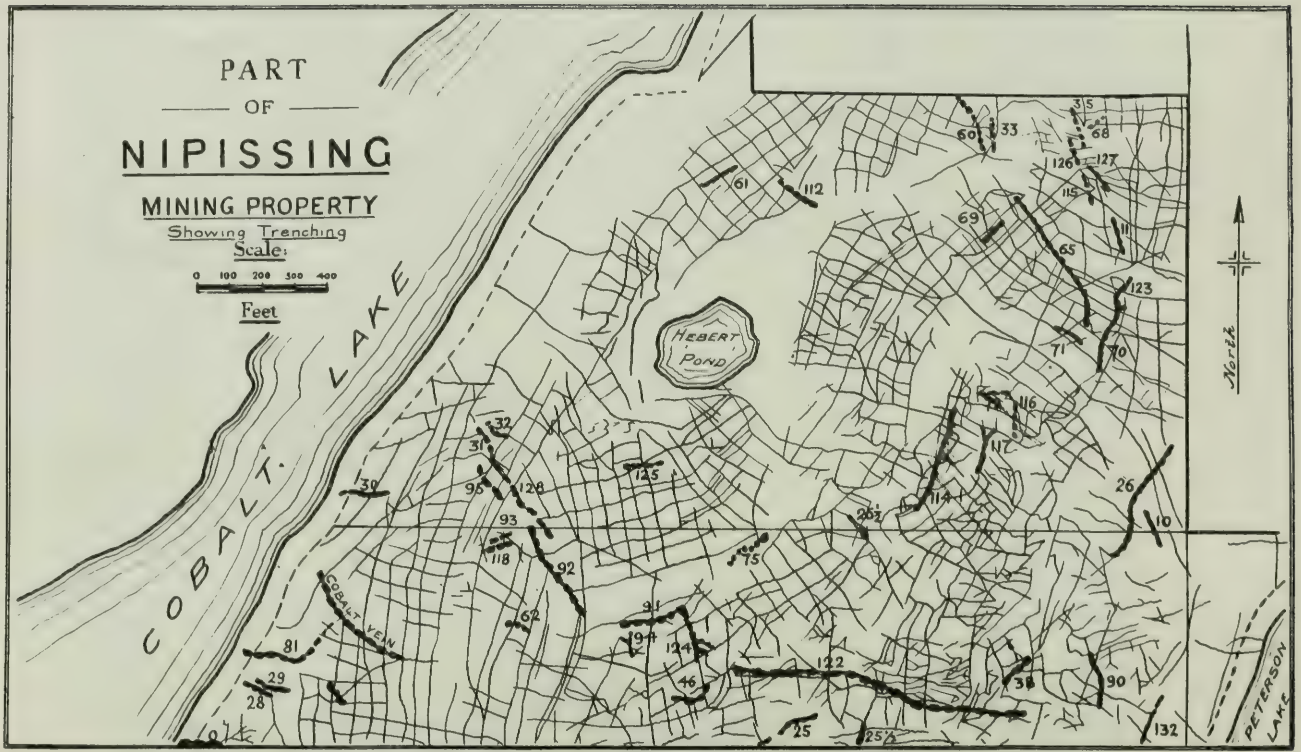
Geology. The silver deposits of the Cobalt District are in pre-Cambrian rocks, most of the valuable ones in Huronian conglomerate, and a few in Keewatin greenstones and post-Huronian diabase. The deposits are probably genetically connected with masses of the diabase, with which they are always closely associated.

The veins are generally nearly perpendicular and are narrow. They are worked from a half inch in width up, but the majority will be under four inches. The vein filling is usually calcite carrying native



RICH SILVER VEIN IN TEMISKAMING MINE; 400-FOOT LEVEL, IN KEEWATIN FORMATION.

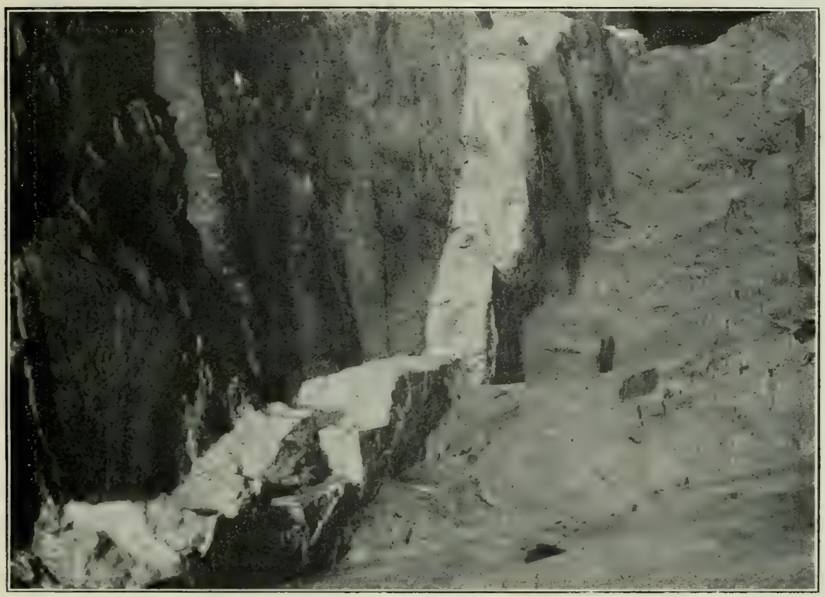
Copyright, 1910, by A. A. Cole.



TRENCHING ON PART OF THE NIPISSING MINING PROPERTY, SHOWING SOME OF THE VEINS.

silver, associated with the arsenides of nickel and cobalt in varying amounts. Faults are numerous but the throw is seldom large.

The average depth of the cobalt-silver-bearing deposits is not great, and it would appear that the present veins are simply remainders, the original overlying and possibly greater parts having been eroded by glaciation. Undoubtedly some of the mines will find values at considerable depths, but these will be the exceptions to the rule. The salvation of the camp, however, lies in the fact that notwithstanding the shallowness of the deposits the veins are numerous.



SILVER VEIN IN CROWN RESERVE MINE, NEAR COBALT.
Width 14 inches; assay 9,000 ounces per ton; 100-foot level in Huronian formation.
Copyright, 1910, by A. A. Cole.

When Cobalt was in its infancy the lure of the wild came to people in all callings of life, and as the miner and prospector formed only an insignificant proportion of the population of the east, it was but natural that among those flocking to the new camp the beginner was much more in evidence than the experienced mining man. It was easy to distinguish between the men who had had some previous mining experience and others by the questions asked regarding mining claims. The former would enquire regarding the number and size of the veins, while the latter, particularly if from the rural dis-

TRENCHING, NORTH DRUMMOND LOT, KERR LAKE, NEAR COBALT.

tricts, the number of acres in the claim. It would now look as if the acreage tenderfoot was unwittingly not so foolish as he appeared to his more experienced brother worker.

Prospecting, Trenching. In opening up a property surface trenching is almost universally resorted to. Parallel trenches are run at more or less regular intervals, and these are joined up with cross trenches. The trench is dug down to bed rock, which is then swept and washed clean, and carefully examined for any signs of silver-bearing fissures. One of the best indicators is the delicate pink coloration of the cobalt bloom. When the ground proves productive the trenches are placed closer together. In the last annual report of the Nipissing Mine, the largest operating company in the district, the manager, Mr. R. B. Watson, says in speaking of trenching:

> "This method of prospecting covers a large area at small expense and is far ahead of underground exploration as a means of finding new veins. At the present rate however, it would take many years to completely trench the property and then many veins would probably be missed.
>
> "The only sure way to find outcrops is to entirely remove all the overburden on the rock surface, and preparations are now underway with this end in view."

The Nipissing Company alone during 5½ months of last year, dug 33 miles of trenches, averaging 3.4 feet deep.

Mining. Early shipments from the camp were made up almost entirely of ore taken from open cuts, but gradually underground development work was pushed, till now most of the ore comes from regular underground mining.

The shafts of the camp with one or two exceptions are vertical. The levels are sometimes placed 100 feet apart, but the distance is usually much less on account of the quick variations, both in value and in size, that take place in most of the veins.

The usual method of taking out ore underground is to run the drift or stope alongside the vein, leaving as much as possible of the vein on the wall, and then breaking down the vein by itself afterwards, and sacking a large proportion of the rich material at once. This mode of taking down the ore gives a minimum amount of fines, if the ore is not frozen to the wall. Another method that is now being introduced is to keep the vein in the centre of the breaking face. The advantages that are claimed for this system are (1) that only the men on the picking tables actually touch the ore; (2) the walls on both sides of the vein are prospected. With the other method only one side is prospected and special work has to be done afterwards in order to test the other wall. The wall rocks frequently carry disseminated values and this makes it all the more desirable to take out the rock adjoining the vein on both sides.

POWER PLANTS.

Power for the operation of the mines was until lately generated by coal and bringing in this fuel formed an important item in the business of the Government Railway. The shipments of coal into Cobalt for 1909 amounted to 105,416 tons.

Three water powers have been developed in the vicinity of Cobalt, aggregating about 16,000 horse power, and when this power became available in Cobalt the coal shipments dropped off almost entirely.

The three companies that have developed the water powers are:—

1. Cobalt Power Company.
2. Cobalt Hydraulic Power Company.
3. Mines Power, Limited.

The Cobalt Power Company has developed 3,000 horse power at Hound Chute on the Montreal River, six miles from Cobalt, and delivers power as electrical energy.

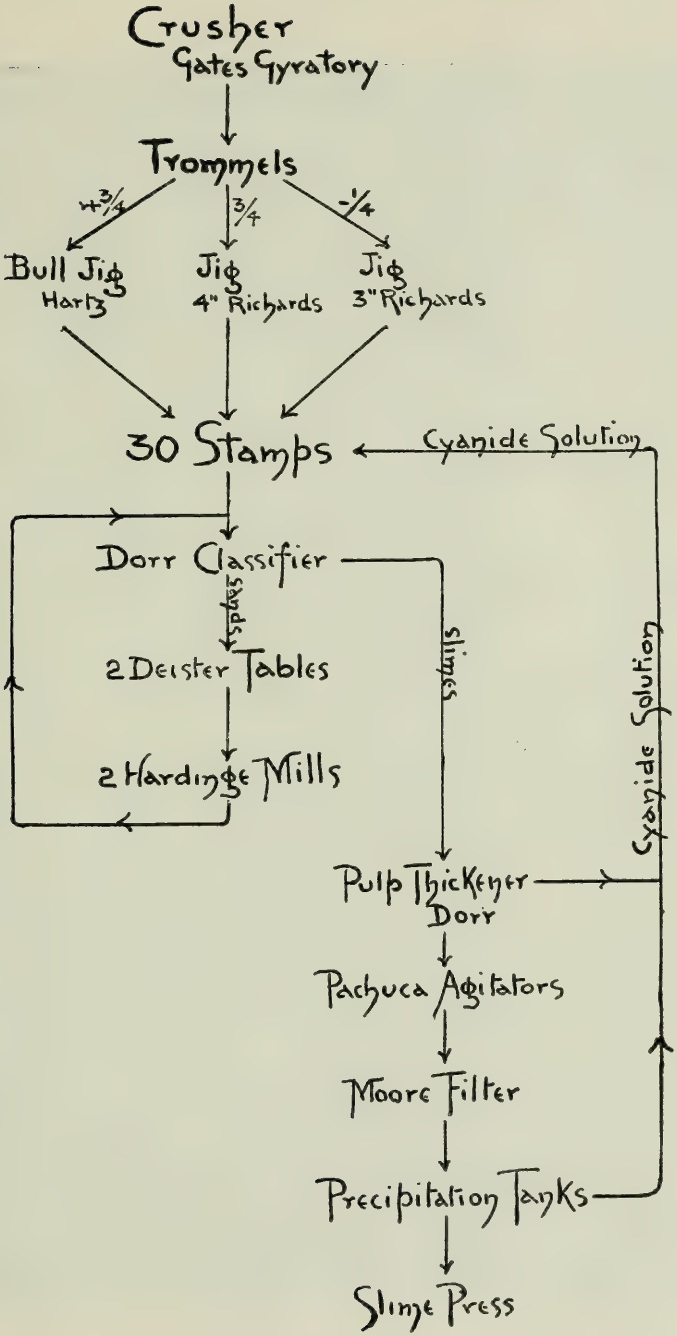
The Cobalt Hydraulic Power Company has developed 4,000 to 5,000 horse power at Ragged Chutes on the Montreal River, and compresses air by the Taylor system. The compressed air is brought to Cobalt through 9 miles of 20-inch seamless flanged steel pipe.

The Mines Power, Limited, has a capacity of 8,000 horse power, the generating plant being 22 miles from Cobalt on the Matabitchouan River. Power is brought into the camp as electrical energy and is there converted into compressed air by electrically driven air compressors.

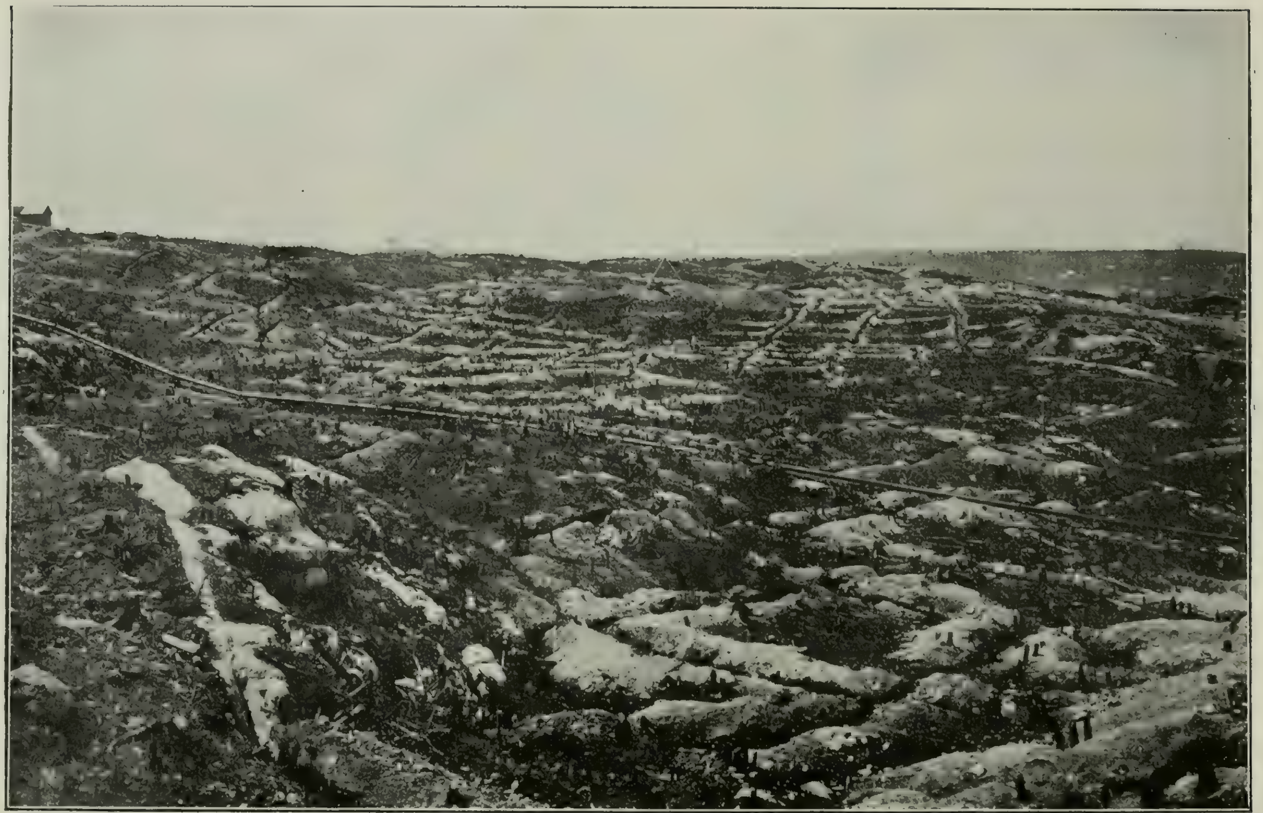
The charges made by the above companies vary with different circumstances, but are about $50 per horse power per annum for electrical energy, and 25 cents per 1,000 cubic feet of compressed air at 100 pounds pressure and atmospheric temperature.

CONCENTRATION. There are at present thirteen reduction mills in operation in the Cobalt District; one more is under construction and others are contemplated. Ten mills use water concentration while the other three use more or less cyanide. The two flow sheets given below are chosen as types of the two classes of mills.

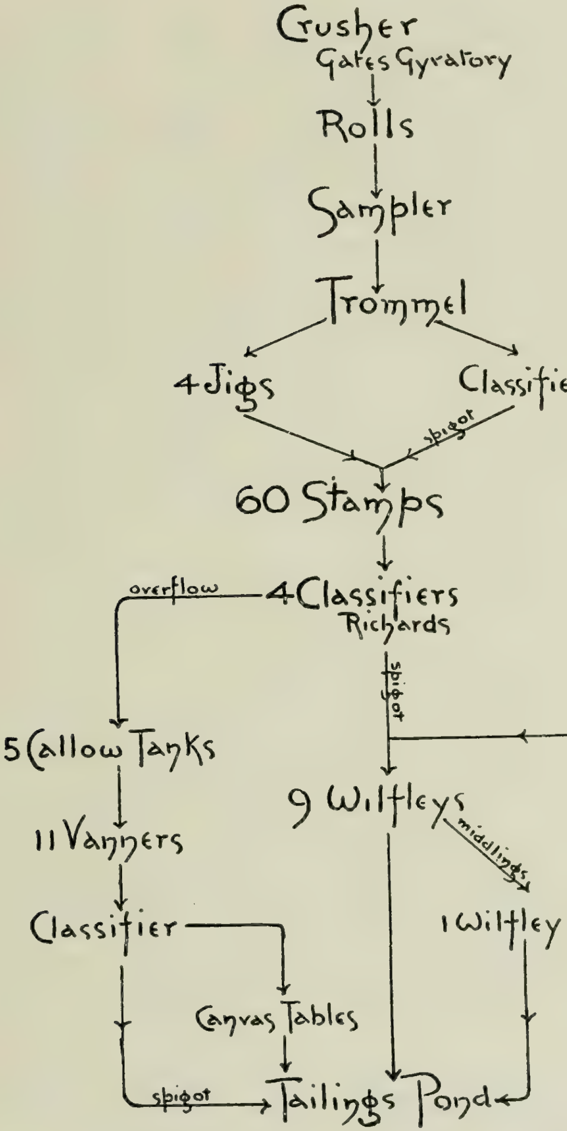
No two flow sheets are exactly alike, but this is what might be expected, as the ore varies greatly in physical characteristics, not only in the different mines but in different parts of the same mine.



FLOW SHEET, O'BRIEN MILL, COBALT.



TRENCHING, NIPISSING MINING COMPANY, OPPOSITE THE TOWN OF COBALT.



FLOW SHEET, NORTHERN CUSTOMS MILL, COBALT.

The great variation in the concentration ratio in the following table is due mainly to the different varieties of ore treated. For instance, the Cobalt Lake ore that was only reduced 5 to 1 was very heavy smaltite ore, while the Bailey ore that gave a reduction ratio of 68 to 1 was mostly native silver in diabase.

CONCENTRATION IN COBALT FOR 1909.

Mill.	Mines.	Ore Milled. Tons.	Concentrates. Tons.	Concentration. Ratio.
1. Buffalo	Buffalo	27,875.0	507.00	55-1
	Bailey	2,482.0	36.24	68-1
	Cobalt Central	21,272.0	362.40	59-1
2. Cobalt Central	Crown Reserve	45.0	1.02	44-1
	Foster	547.0	10.20	54-1
	Kerr Lake	1,093.0	104.79	10-1
3. Coniagas	Coniagas	19,671.4	465.70	42-1
4. Colonial	Colonial	1,500.0	25.00	60-1
5. King Edward	King Edward	4,769.6	105.43	45-1
6. McKinley-Darragh	McKinley-Darragh	18,703.0	741.59	25-1
7. Nipissing Red Co.	Nipissing	9,597.0	229.00	49-1
	Cobalt Lake	301.9	60.00	5-1
	City of Cobalt	2,576.3	57.01	45-1
	La Rose	5,988.2	255.62	23-1
	Nancy Helen	284.9	5.87	49-1
8. Northern Customs	Nova Scotia	1,173.1	39.71	30-1
	Right of Way	1,289.7	28.22	46-1
	Silver Queen	2,371.9	132.68	18-1
	Trethewey	1,130.8	17.02	66-1
9. O'Brien	O'Brien	3,749.5	57.00	[*]. . . .
		126,421.3	3,241.50	[†]39-1

MARKET. During the first six months of 1910 Cobalt shipped 14,843 tons of ore for treatment as follows:

Canada	4,782.63	Tons, or	32.22 per cent.
England	153.65	" "	1.00 per cent.
United States	9,816.70	" "	66.13 per cent.
Germany	90.10	" "	.65 per cent.
Totals	14,843.08	" "	100.00 per cent.

It is noteworthy however that the three Canadian smelters handling Cobalt ores accept no low-grade material, so that while the tonnage treated by American smelters is greater than in Canada, the actual value of the ore refined in Canada is greater, being over 50 per cent of the total shipments.

CONCENTRATION. The tonnage milled during 1910 promises to be more than double that milled in 1909. The average extraction in the mills in the Camp is about 80 to 85 per cent, depending on the character of the ore and grade of the mill heads, at an average cost of about $3.00 per ton. The following table shows the proportion of the concentrates saved by the different parts of three of the mills.

---

[*] No comparative ratio can be stated for O'Brien, as all low grade concentrates were cyanided and yielded 12,656 ounces, which was shipped as bullion.

[†] The O'Brien is omitted from this ratio.

CONCENTRATES.

Mine.	Jigs. Per Cent.	Tables. Per Cent.	Cyanide. Per Cent.
Buffalo	52.39	42.69	4.92
Coniagas	40.60	59.40	...
McKinley-Darragh	53.70	46.29	...

The grade of ore treated will average about 25 ounces per ton, varying from 100 down to 10 ounces. Above 100 ounces per ton it will usually pay to ship to the smelter without further treatment.

PRODUCTION. The first silver discovery was made in the district in the fall of 1903, and the first shipment the following year. Since that time steady progress has been uninterrupted, as is evidenced by the following table:

Year.	Tonnage.	Value.
1904	158.55	$136,217.00
1905	2,336.01	1,485,570.00
1906	5,836.59	3,573,908.00
1907	14,851.34	6,155,391.00
1908	25,362.10	9,133,378.00
1909	29,942.99	12,356,442.00
1910 (6 mos.)	14,843.08	6,260,000.00
	93,330.66	$39,100,906.00

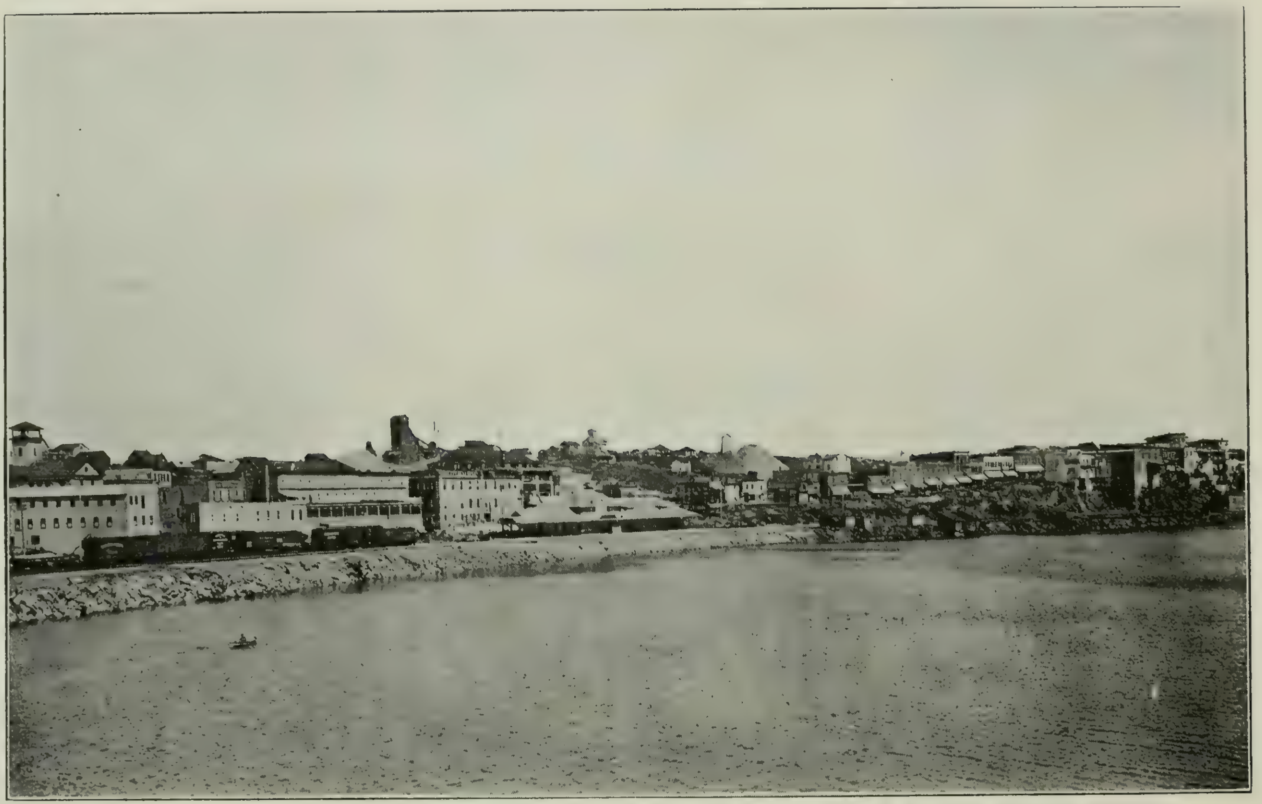
This easily places Canada in the third place among the world's silver producers, being surpassed only by Mexico and the United States in the order named. Only a small proportion of Canada's production comes from outside Cobalt. *Cobalt now produces one-eighth of the world's production of silver.*

MINING COSTS. The record of mining costs in Cobalt may be worked out as follows:

	Tons.	Value.	Dividends.
1904 to 1910 (6 mos.)	93,331	$39,000,000	$20,900,000

$$\text{Cost per ton} = \frac{18,100,000}{93,331} = \$194.00$$

These look like notoriously high working costs when compared casually with other mining camps, but if the shallowness, irregularity, and narrowness of the average ore shoot in Cobalt is taken into consideration it will be seen that the above really represents excellent mining practice.



PART OF TOWN OF COBALT, WITH HEAD FRAMES OF CONIAGAS AND TRETHEWEY MINES IN THE BACKGROUND.

The one condition that has the greatest influence on the cost of producing silver is the value of the ore. It costs nearly as much to mine a ton of 100-ounce ore as a ton of 10,000-ounce material. One of the richest of the shippers produced over 4,000,000 ounces of silver during 1909 at a cost of 10.31 cents per ounce. In making this calculation not only were all mining and marketing costs included, but office expenses, and 20 per cent was deducted for depreciation on buildings, plant and equipment. This of course is an exceptional case, but several others of the large mines are producing silver from 12½ to 22 cents per ounce. Taking the average cost per ounce of six shippers as 18 cents, and the average value of silver for 1909 as 51.5 cents, it will be seen that 33.5 cents are left to pay dividends. This makes it easy to understand why such an exceptionally large proportion of the Cobalt production can be paid back in dividends to shareholders.

Dividends. Viewed from a dividend standpoint the results achieved by Cobalt are unusually satisfactory. Up to the end of the first half of 1910 the total dividends paid amounted to well over $20,000,000; in other words, more than 50 per cent of the total production has already been paid back to shareholders of the shipping companies.

Two factors have been at work in 1910 which should further increase the proportion of dividends to total production, viz., the introduction of power from hydraulic developments, reducing the cost of production, and secondly the rise in the price of silver, which will increase the smelter returns. The average price of silver for 1909 was 51.50 cents per ounce. The average price for the first six months of 1910 was 52.65, or 1.15 cents better. This means an additional annual income of $300,000 for Cobalt.

Ore Reserves. A feature that has been misinterpreted by many people regarding Cobalt is the comparatively small ore reserves compared with the valuation put on the properties in the stock markets. In coming to a proper conclusion in this respect it is well to remember the circumstances under which most of the properties have been opened up. The ore was found rich from the surface, so instead of having to put in expensive plants to begin with, and to do extensive development work, the surface ore was taken out at once and realized on. Most of the directors of Cobalt mining companies were previously unfamiliar with mining and it was hard for the mine managers to get a chance to do any development while there was any ore in sight. Pressure was constantly brought to bear on the manager to take out the ore just as soon as encountered. As a natural consequence several of the mining companies had bad temporary setbacks. Gradually better practise has prevailed, and for the past two years the ore reserves have gradually increased, notwithstanding a rapidly rising production, till now the ore reserves equal *two years' production at the present rate of output.* This is a higher level than the ore reserves of the camp have ever before attained, and indicates a very healthy state of affairs.

THE FUTURE. The physical condition of Cobalt was never better than at present. Systematic development is bearing fruit and numerous good finds are constantly being made. Thus during 1910 noteworthy finds of productive silver veins have been made on at least twelve of the shipping properties.

Faith in the stability of the camp for some time to come is evidenced by the amount invested in the district by interested companies. For instance, the amount invested in water-power development is more than $3,000,000, while the reduction mills of the camp have cost more than $1,000,000 to put in operation. The money for these has been put up by clear-headed business men, thoroughly familiar with conditions in the district. They realize also that if their investments are to prove satisfactory, both the principal and interest must be paid back during the life of the mines, and they are satisfied with the outlook. Flourishing little towns have sprung up in the neighborhood of Cobalt, dependent in large measures on the mines of Cobalt for their existence. Large and substantial buildings are being erected, and waterworks and other municipal improvements are going in.

Boom days are now over and the camp has settled down to a rational business level. This has caused the ever present pessimist to raise his head and recommence his wail of dismal forecasts for the future. Everyone knows that Cobalt cannot last forever, and even now the lame ducks are beginning to drop out of the flock. Nevertheless, Cobalt is now steadily producing more than *one million dollars* ($1,000.000) *worth of silver each month,* and the future is silvery bright.

Every year of the camp's existence has shown a larger silver production than the previous one, and 1910 promises to be no exception.

When in the future the Cobalt mines are worked out it will be found that the camp has totalled such a magnificent production that it will be entitled to a position in the forefront among the historical mining camps of the world.

COST KEEPING IN SMALL FACTORIES.

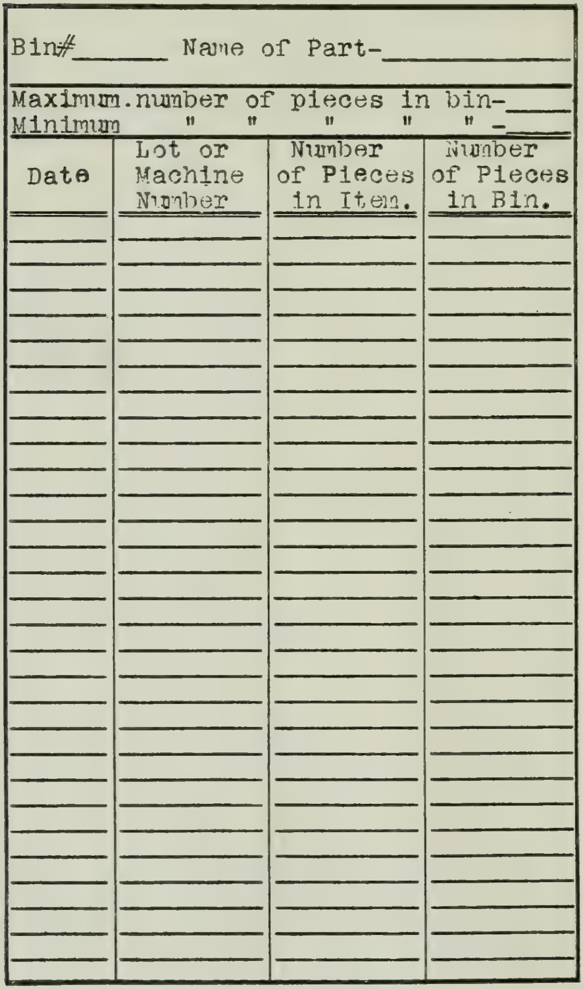
By Paul R. Powell.

Mr. Powell's purpose is outlined in his opening paragraphs. It is to formulate a cost system which will be well within the means of the modest plant, and yet supply information fully adequate to the needs of the business. He would thus put the small shop relatively abreast of the large one in exact knowledge of what it is doing, at an expenditure of time and money wisely proportioned to the amount of its turn over.—The Editors.

TWO or three decades ago, when the demand for most commodities far exceeded the supply, the attention of business men and manufacturers was turned solely upon getting their orders filled, without taking time to seeing whether they were filled in the cheapest way possible. A firm would go over its books, perhaps once a year, and balance up its accounts to see how much money it had made. As the supply began to catch up with the demands, however, and competition became keener, the margin between gain and loss began to get so small that more attention had to be given to methods in order to do the work more cheaply. Thus it was found necessary to know the results of the business more frequently than once a year; so the accounts were cast up once a month and, as even this gradually became insufficient, the big companies began to install their elaborate cost systems which today tell them exactly where they are making money, almost to the hour.

This is particularly true in regard to manufacturing firms; many of the big ones know their costs of production, down even to how much it costs to drive a nail. It pays them to go into the matter so minutely because they drive so many nails that any improvement in the method, even of this simple operation, will net a saving that will more than offset the cost of the calculations. As these systems spread to the smaller factories they are often found to cost more than they are worth, and the managers give up cost keeping entirely, on the ground that their shops are too small to make it pay. They do not seem to realize that though they cannot afford to know the cost of driving nails, by combining this with sawing wood, etc., they can very easily afford to figure the cost of the piece, and that to a degree of accuracy that will be of just as much value to them as the more intricate figures are to their big competitors. No firm doing work on a small scale can hope to go into the minute details that a big factory can, and make it pay; that is the advantage of the big organization which nothing can offset.

On the other hand, by combining these details, and further by combining the whole system with some of the other systems of the factory, such as the stock accounts and time keeping, a very satisfactory and inexpensive method of keeping costs may be reached. It would seem at first that this combining would lead only to greater complications than if the accounts were kept separate, but in a factory these accounts are so interwoven that ordinarily entries have to be made two or three times, that in the combined system need only be done once. In this way a great deal of time can be saved which will in part, if not wholly offset that used in cost keeping. I will describe below such a system involving a continuous stock account, time keeping, record of patterns, and a quick



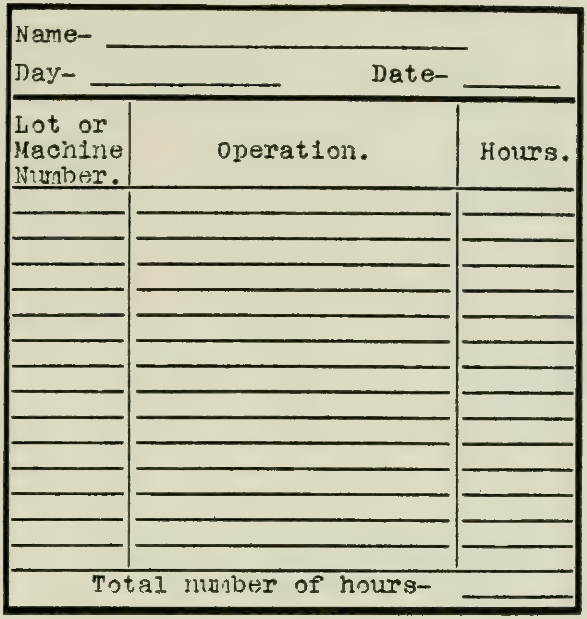
Bin#_____ Name of Part-__________

Maximum.number of pieces in bin-____
Minimum " " " " " -____

Date	Lot or Machine Number	Number of Pieces in Item.	Number of Pieces in Bin.

FIG. I. BIN CARD.

means of checking materials received with the orders as well as cost keeping and a record of the costs of the different materials; it is especially adapted to a shop employing from twenty-five to two hundred men and manufacturing a stock line of machines for the market.



Name– ____________

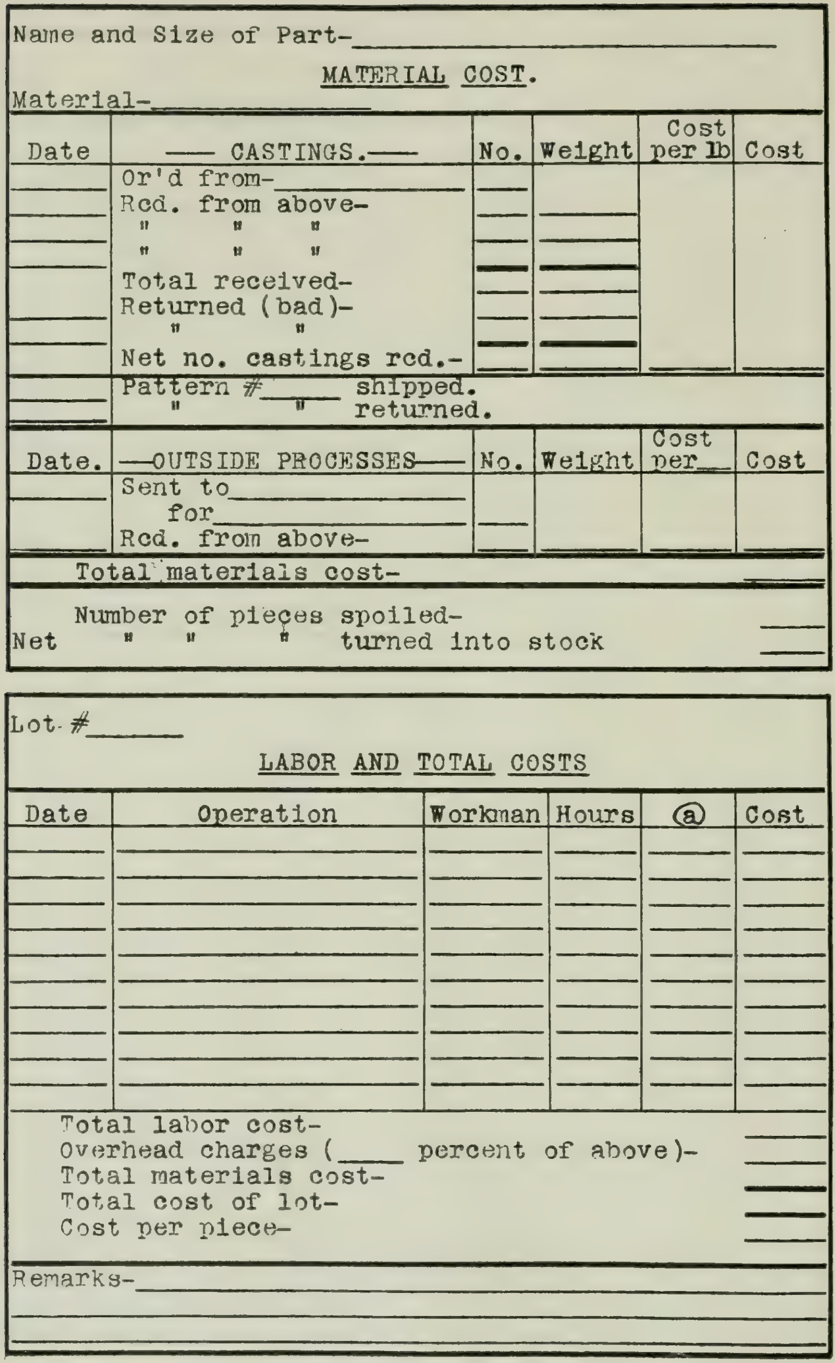
Day– ________ Date– ______

Lot or Machine Number.	Operation.	Hours.
Total number of hours–		

FIG. 2. TIME CARD.

This system is kept on four sets of cards, the first two of which would be necessary to any shop whether it keeps costs or not. These are the "bin card" (Figure 1) and the "time card" (Figure 2); the former is an account of the number of each kind and size of part in stock finished and ready to be built into the machines, and is necessary to the manager in ordering new material. The latter is a regular time card and each workman makes one out for every day he works, stating the work he did and the number of hours; without this it would be impossible to pay off the men. The other two sets of cards are primarily cost cards, of which the first (Figure 3) gives the cost of making up each lot of parts and the second, (Figure 4) the cost of building and preparing for shipment each machine. The former is also used to check up orders for new castings, and as a record of the patterns, as well as the time and materials needed to finish the parts. The latter gives the time on building each machine and also constitutes a valuable record of the machine for future reference; this card may also be used for repair jobs with a very little alteration.

The first requisite, in fact absolute necessity, is careful co-operation on the part of the manager and foremen with the cost clerk in order that jobs may be pushed through and the shop kept in as systematic a manner as possible. No jobs should be left lying about the shop unless work is being done on them; all others must be returned



Name and Size of Part-____________

MATERIAL COST.

Material-__________

Date	—— CASTINGS.——	No.	Weight	Cost per lb	Cost
	Or'd from-__________				
	Rcd. from above-				
	" " "				
	" " "				
	Total received-				
	Returned (bad)-				
	" "				
	Net no. castings rcd.-				
	Pattern #_____ shipped.				
	" " returned.				

Date.	—OUTSIDE PROCESSES—	No.	Weight	Cost per___	Cost
	Sent to__________				
	for__________				
	Rcd. from above-				

Total materials cost-

Number of pieces spoiled-

Net " " " turned into stock

Lot #______

LABOR AND TOTAL COSTS

Date	Operation	Workman	Hours	@	Cost

Total labor cost-

Overhead charges (_____ percent of above)-

Total materials cost-

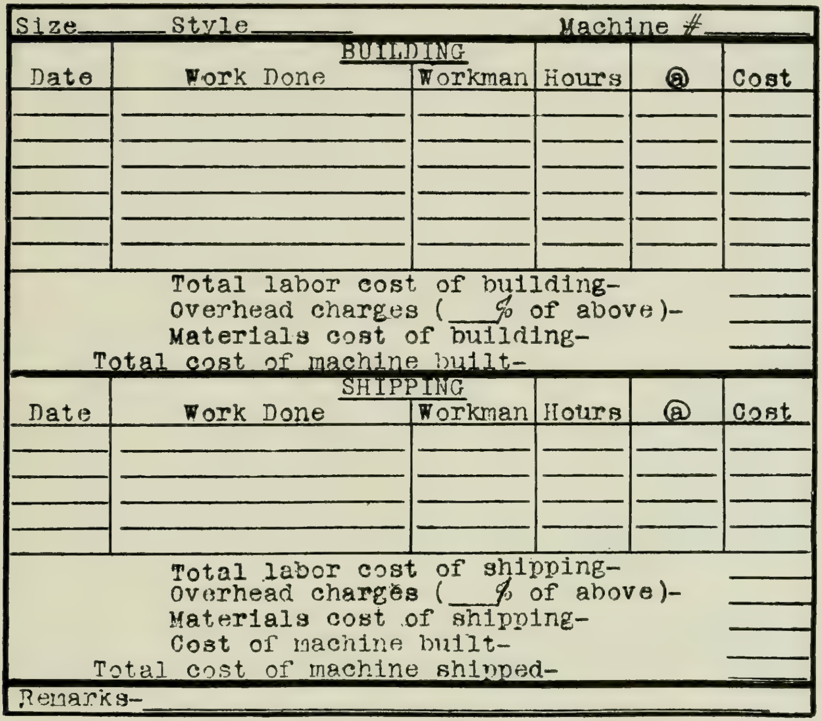
Total cost of lot-

Cost per piece-

Remarks-__________

FIG. 3. LOT CARD. FRONT AND BACK.

to the stock room. This evidently requires an enormous stock room, but it keeps the castings and other material where they can easily be kept in order, thus leaving the shop free for the work that is being done; and after all, the total space required is the same whether more or less of it is fenced into the stock room.



Size______ Style______ Machine #______

	BUILDING				
Date	Work Done	Workman	Hours	@	Cost

Total labor cost of building- ______
Overhead charges (___% of above)- ______
Materials cost of building- ______
Total cost of machine built- ______

	SHIPPING				
Date	Work Done	Workman	Hours	@	Cost

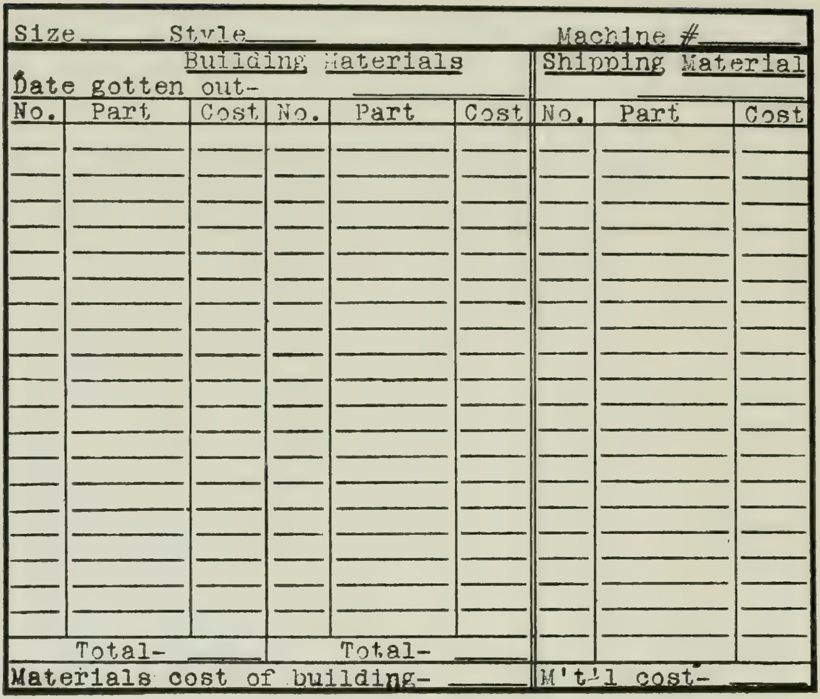
Total labor cost of shipping- ______
Overhead charges (___% of above)- ______
Materials cost of shipping- ______
Cost of machine built- ______
Total cost of machine shipped- ______

Remarks-______

FIG. 4. MACHINE CARD. FACE.

For purposes of identification each lot of parts being worked on is given a "lot number," and each machine a "machine number." The lot number is marked on the castings or, if they are too small, on the box in which they are given out, in order that the lot may be kept together and that the workman may enter it properly on his time cards. The number of pieces in the lot should also be marked, thus making it impossible for the workman to avoid reporting any pieces he may spoil. The machine numbers are also for aid in making out the time cards and are stamped on the name-plates of the machines; they are of great assistance in looking up old machines on which repairs are to be made.

In the stock room every part has a bin, rack, or floor space where



Size______ Style______ Machine #______

Building Materials						Shipping Material		
Date gotten out-								
No.	Part	Cost	No.	Part	Cost	No.	Part	Cost
Total-			Total-					
Materials cost of building-						M't'l cost-		

FIG. 4A. MACHINE CARD. BACK.

all completed pieces of that part are kept, so that the stock-keeper can find them the minute they are wanted. An account of the number of each of these parts is kept on a bin card, of which the first two columns are for the date and number of the lot or machine on which the item is received or issued, and the last two are for the number of pieces in the item and the resulting number in the bin respectively. At the top are spaces for the name of the part, the number of the bin, and the maximum and minimum number of pieces to be kept in it. The items are entered as the lots are received or the machines gotten out, thus keeping a continuous record of the number of pieces in the bin. When this number falls below the minimum enough new pieces are ordered to bring it up to the maximum, thus keeping it fluctuating between these limits, which are set far enough apart to require ordering once in two or three months. The limits may be varied from time to time as the amount of work done by the shop changes, for it is economy to keep only enough stock on hand to avoid delays due to shortages of materials.

For each lot of new parts a lot card is made out, on one side of which is kept a record of the castings as they come in, and when the total number in the lot has been received their cost is figured. Below this is kept a record of the pattern and any work that is done by outside firms; this is entered under the heading "Outside Processes" and the cost is added to the cost of the castings to get the total materials cost of the lot. At the bottom of the card is kept a record of the number of pieces spoiled in finishing and the resulting number completed and turned into the stock room. This side of the card, of course, will have to be modified for pieces that are not made from castings, or in many cases the cost items may be made out direct.

The reverse side of the card is simply an account of the labor done on the lot, and its cost; the first four columns are made out from the time cards. The column headed @ is for the cost of each man's work per hour, which is the sum of his wages and the cost of running his machine; this multiplied by the number of hours gives the cost of each operation, and the sum of these costs gives the total labor cost on the lot. "Overhead charges" is the allowance made for all those expenses that cannot be attributed to any one job; once a year the sum of these expenses is taken and reduced to a percentage of all the total labor costs of the year. This percentage is taken for the ensuing year, giving as accurate a division of the general expenses as is possible in a small establishment. The sum of the total labor cost, overhead charges, and total materials cost, which is taken from the other side of the card, gives the total cost of the lot, which divided by the number of finished pieces gives the cost per piece.

The machine card is kept in the same way. On one side is a list of the parts and their costs, which are taken from the lot cards, and on the other are the labor and total costs. The accounts for building and shipping are kept separate in order to determine the costs of each of those operations. It probably would not pay to have a set of these cards printed for every size and style of machine, so the list of materials is printed blank and filled in later with one of the many letter duplicators on the market.

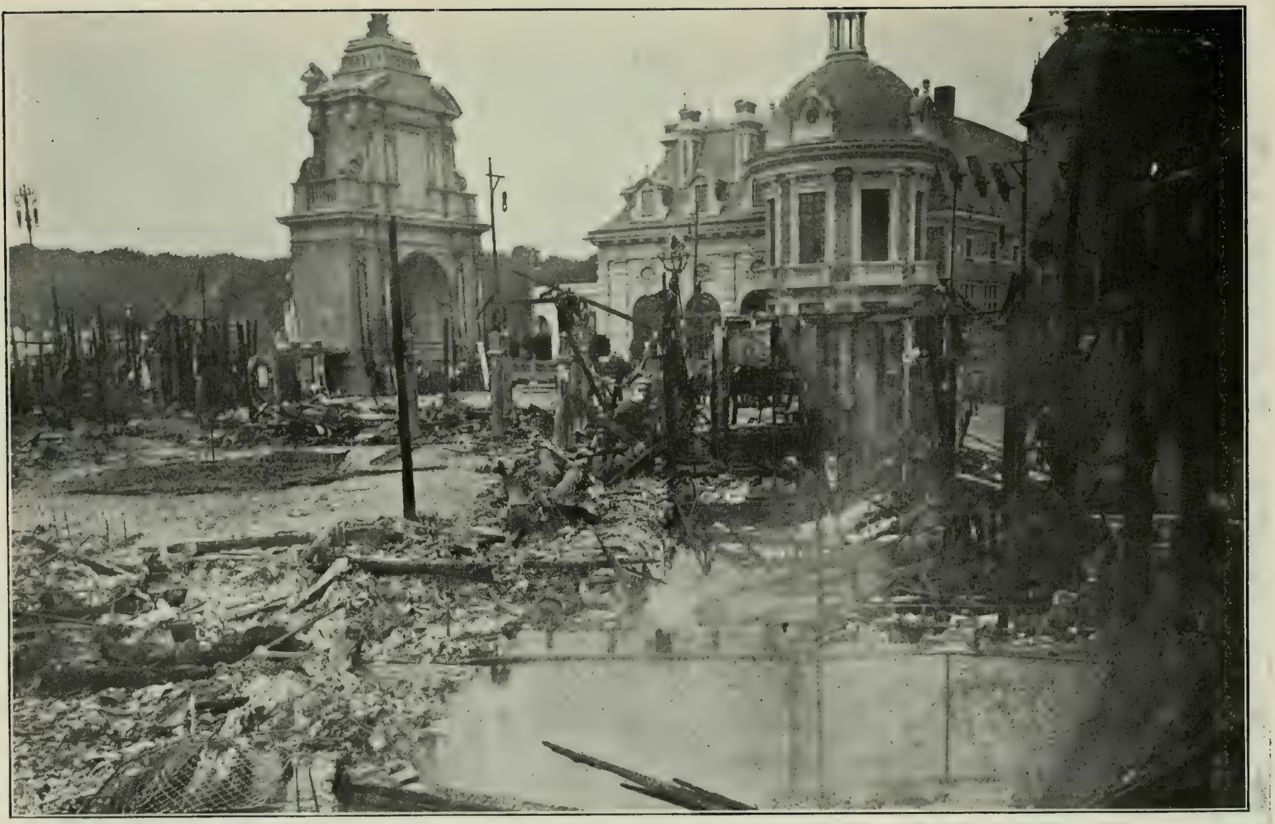
This is the general plan of the system; of course the details will have to be worked out to fit the individual case. Perhaps also some of the principal features will have to be changed, but the simplicity of the system makes this very easy to accomplish.

THE DESTRUCTION OF THE BRUSSELS EXPOSITION.

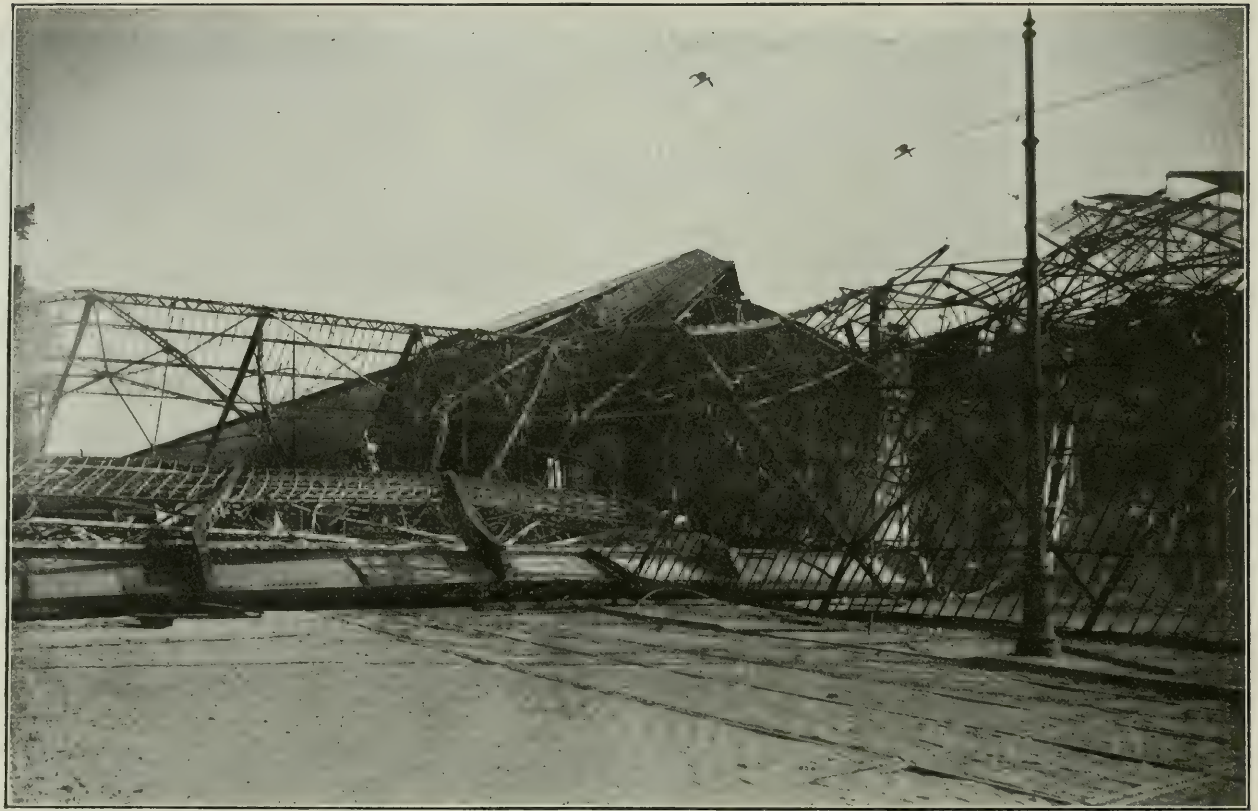
THE photographs on the following pages give some idea of the completeness of destruction wrought by fire at the Brussels Exposition last August—destruction resulting largely from inefficiency of fire protection. According to reliable accounts, there was but one steam fire-engine within the grounds, and three or four engines worked by hand power. The fire companies from outside, most of them volunteer organizations, were under command of individual chiefs, and none could take orders from anyone else than its own commander, the consequence of course being almost hopeless confusion. The water pressure also was very inadequate, the stream in one typical instance reaching a height of but ten metres while the blaze was fifteen metres from the ground.

It is most interesting to note here again, as in many instances lately cited in these pages, that the inefficiencies can all be clearly identified and traced to violation of some one of the "Twelve Principles of Efficiency": lack of proper constructive organization, but in its place irresponsible power at the top—delegated duties and responsibilities without proper instruction—anarchy all down the line; lack of farseeing common-sense; lack of discipline; lack of standard appliances; lack of standard practice instructions.

The blowing up of the bridge shown on page 40 alone saved the whole of the Exposition from being destroyed. Thus, as elsewhere, in default of efficient provisions, destruction was met and overcome only by counter-destruction.



A PART OF THE OLD BRUSSELS GROUNDS. ONLY THE MAIN ENTRANCE AND THE RESTAURANT WERE SAVED.



THE BRIDGE CONNECTING THE BRITISH AND FRENCH SECTIONS. ITS DESTRUCTION SAVED THE WHOLE EXHIBITION FROM PROBABLE DESTRUCTION.

POWER REQUIRED FOR ROLLING STEEL.

By J. A. Knesche.

A description with data and results of original and carefully conducted tests on direct-driven plate mills, giving valuable figures of power consumption and a discussion of the elements affecting the power required. The present installment describes the apparatus and the mode of testing adopted. A succeeding part, in November, will publish the results.—The Editors.

DURING the year 1907 I carried on a number of engine tests which had for their purpose the determination of the power required to roll steel. These tests were conducted at a considerable outlay of time and money, and it is thought the results from these investigations and the conclusions drawn therefrom will be of interest to many metallurgical men whose duties bring them into contact with the engineering phases of rolling-mill work.

At the start it was realized that in order to make these investigations of any practical value all data would have to be secured with the greatest possible accuracy. It was well understood that the greatest degree of accuracy could be attained by taking all data in an automatic manner. This, however, could not be done in the present case because the mills and engines on which these experiments were performed could not be set aside for experimental purposes only. All data had to be secured in such a manner as not to interfere with the regular operation of the mills.

Description of the Mills.

The tests were made on four 22-inch three-high plate mills consisting of three stands of rolls, viz., one stand of three-high roughing rolls, one stand of three-high finishing rolls, and one stand of two-high finishing rolls. It will not be necessary to describe all four mills since they are all alike in general arrangement and dimensions.

Each mill is driven by a single-expansion steam engine, 36 inches by 48 inches making normally about 72 r. p. m. The shafts of the several engines carry flywheels from 20 to 24 feet in diameter which weigh from 60,000 to 65,000 pounds. These engine-shafts are directly connected to the mill driving shafts. The power is transmitted from the mill driving shafts to the rolls through pinions and

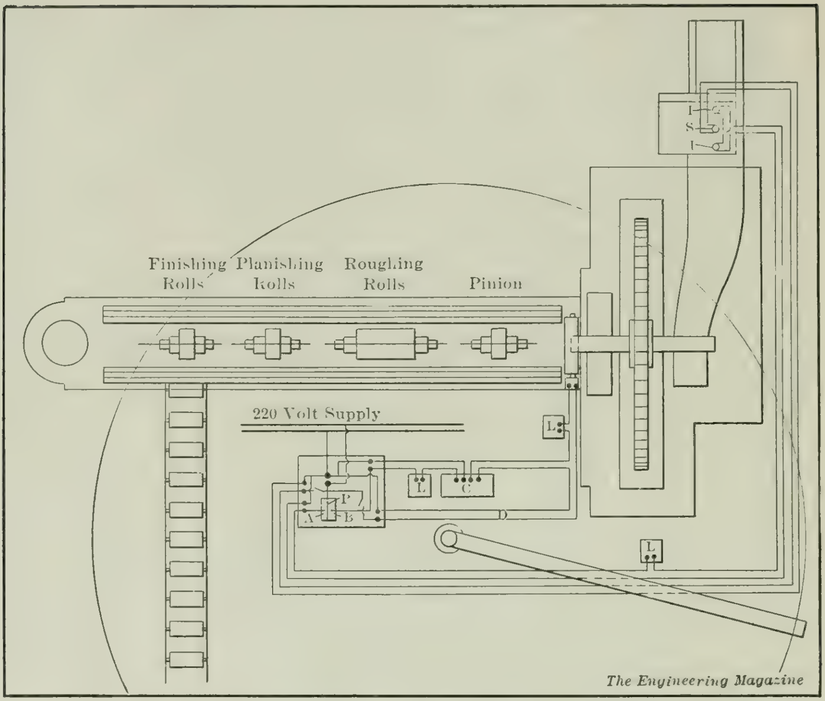


FIG. 1. GENERAL ARRANGEMENT OF MACHINERY AND TESTING APPARATUS.

the usual muff connections. In general arrangement the lay-out of the mill and engine proper is as shown in Figure 1. This illustration shows also the instruments in place with connections.

Quantities to Be Measured.

As stated before, the purpose of these tests was to determine the power required in rolling steel. A further purpose was to develop a method by means of which the power required for any rolling mill about to be designed could be determined, when the rolling mill in question is to produce a certain tonnage under normal operating conditions. In order to accomplish this further purpose it would not have been satisfactory to find out merely how many horse power are required for the rolling of the given plates, because the results obtained from the solution in this manner of the problem at hand would be applicable merely to the rolling of shapes under conditions identical to those existing at the mill where the tests had been made. While it is very well to have such data, it is thought that the power required for a *unit of effect produced* in rolling-mill work will be of greater service in the choice of the proper size of engine or motor for the mill.

From the above reasoning it was decided that if we know the power required to bring about the reduction of one square inch for the length of one foot, we will have a "unit of effect," so to speak, which answers excellently in the computations for the choice of the proper size engine or motor for the mill which may be under consideration. This unit of effect is expressed in the formula

$$\frac{W}{R\ L}$$

in which

W=the total work done on mill driving shaft minus friction load;
R=the total reduction in square inches from one pass to the next one, and
L=the length of the steel in feet after the pass in question.

I have chosen to call $\frac{W}{R\ L}$ "Constant C" in this discussion, because the work required to produce a certain effect under like conditions on like material should always be the same.

The unit of effect produced in rolling steel would not have to be expressed in the manner given above. Dipl. Ingenieure J. Puppe, who conducted very extensive investigations on many different mills and shapes of steel for the Committee on the Power Requirement for Rolling Mills, at the instance of the *Verein Deutscher Eisenhüttenleute,* uses the formula

$$\frac{(Q_1-Q_2)\ L_1}{E}$$

in which

Q_1-Q_2=the cross-sectional areas before and after any pass respectively;
L_1=the length of the piece before the pass, and
E=the energy expended on the pass in question.

It is readily seen that this formula is practically of a nature similar to the "Constant C" formula of the author. The German formula might be written

$$\frac{V}{E}$$

V and E respectively representing the volume displaced and the energy expended during a certain pass. If this ratio is expressed in

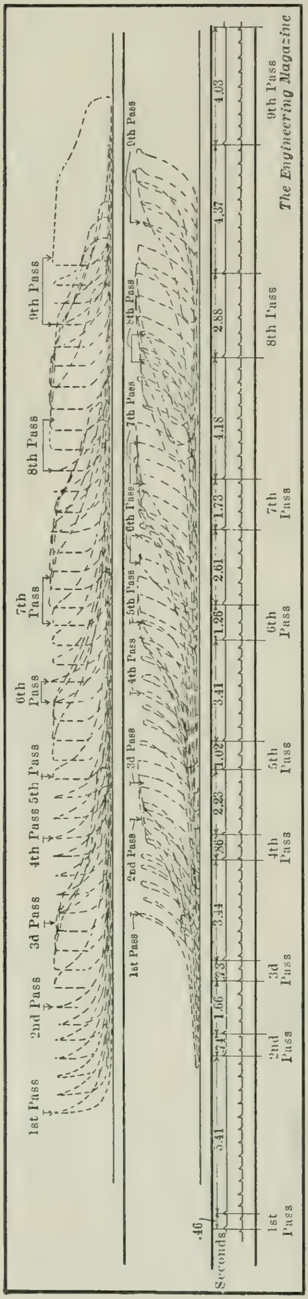


FIG. 2. SHOWING CONTINUOUS INDICATOR DIAGRAMS WITH DURATION OF PASSES, INTERVALS BETWEEN PASSES, AND EACH HALF REVOLUTION OF THE ENGINE.

cubic inches and horse-power seconds, the quotient would give the cubic inches which under the existing conditions can be displaced for every horse-power second of energy exerted at the mill driving spindle.

We will now return again to the quantities to be measured in these tests. In the numerator of Constant C for a given test, W represents the energy expended; this quantity may be and usually is made up from two sources—from the energy of the steam in the engine cylinder, and from the energy given out by the flywheel.

The power developed in the engine cylinder was determined by means of continuous-diagram indicators. Two such instruments, electrically controlled, one for the head-end and one for the crank-end of the engine were used. Sample diagrams are shown in Figure 2. In discussions on this subject of rolling mills operated by electricity and by steam one finds frequently a great deal said about the unreliability of rolling-mill engine tests where a steam-engine indicator must be employed to determine the energy furnished by the engine cylinder; on this point I shall have something to say later.

As stated before, the numerator of Constant C is made up of the energy given out by the steam in the engine cylinder and of the energy given out by the flywheel. In order to figure the energy furnished by the flywheel, the weight of the flywheel entering into the computations and the speed of the wheel both immediately before and after the pass must be known. Arrangements must be made to measure the speed of the revolving masses with great accuracy at the periods mentioned. For this purpose a chronograph with electric pen movements was employed. The instrument used is shown in Figure 3.

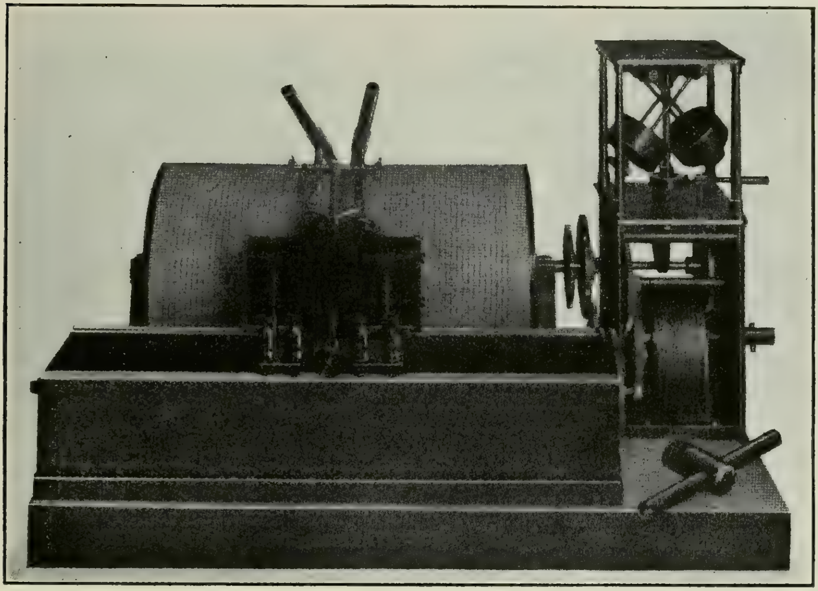
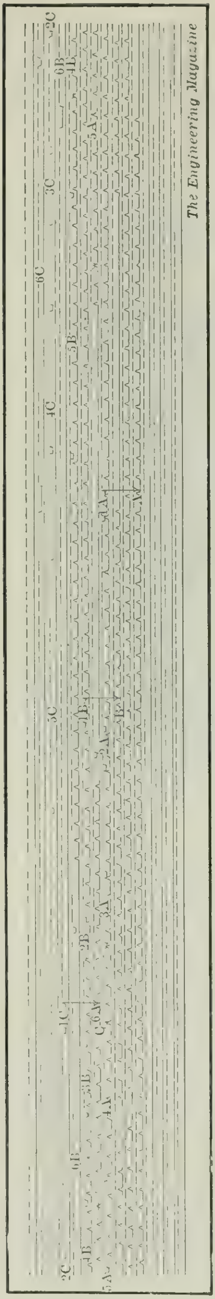


FIG. 3. CHRONOGRAPH WITH TWO ELECTRICALLY OPERATED PENS.
One pen was used to record the beginning and end of pass and interval; the other, to record each half revolution of the engines.

From the illustration it will be noticed that the chronograph carriage has two pens. One is used to record the length of time of each revolution of the engine, while the other pen records the beginning and the end of every pass. A chronograph record sheet is shown in Figure 4. During the test one pen was filled with red ink and the other with black ink, to distinguish readily the revolution record from the record of the length of time of the different passes. The designations 1A, 2A, 3A, 4A, etc., refer to the first, second, third and fourth passes of billet "A." The engine-revolution records belonging to each billet are pointed out by the arrows.

The home-made device shown in A in Figure 5 was used to cause the automatic revolution records to be traced on the chronograph drum. From the illustration its construction and manner of appli-



The Engineering Magazine

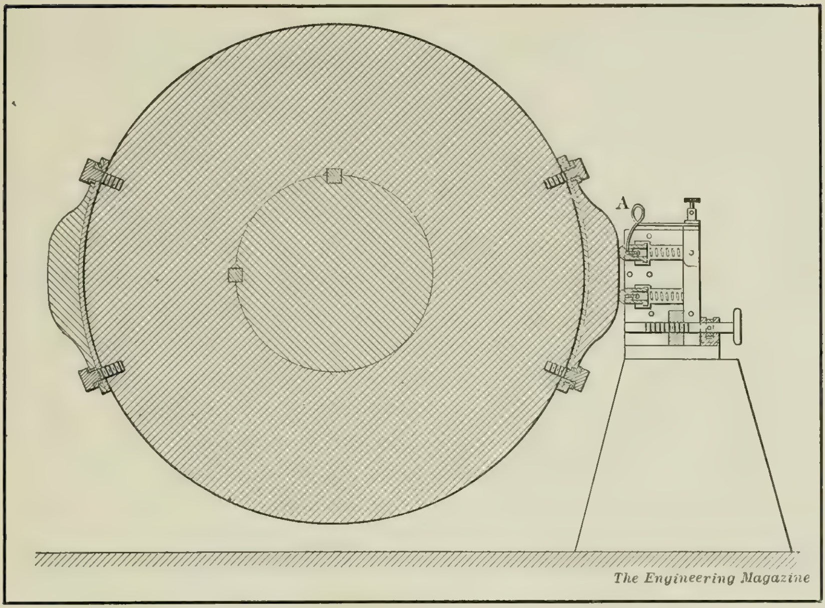
FIG. 4. CHRONOGRAPH RECORD SHEET. A, B, AND C REPRESENT SEPARATE BILLETS.

The points of the arrows are resting on engine-revolution records, while the other ends of the arrows indicate the beginning of the first pass. 1A, 2A, 1B, 2B, 1C, 2C, etc., indicate the different passes for billets A, B, and C.

cation are readily seen. In the preliminary experiments (of which it was necessary to make quite a number before all instruments were in perfect working order and before the observers were sufficiently trained), only one contact piece, insulated properly, was placed on the engine shaft and mill-driving spindle coupling. But since the first few passes are of less than one second's duration, it became necessary to place another contact piece on the above-mentioned coupling so as to be able to measure more accurately the duration of these first passes. The center of this second contact piece was placed at an angle exactly 180 degrees from the center of the first contact piece, and in this manner the chronograph record gave the engine speed for every one-half revolution. Figure 5 shows how the properly insulated contact pieces were placed on the coupling.

By using a strong magnifying glass it was possible to measure the distances between the individual record marks easily and accurately to within 0.005 inch. Since with the fast speed of the chronograph the surface of the drum moved over the distance of 0.61 inch per one second, 0.005 inch meant that the time readings were accurate to within less than 0.01 of a second. The chronograph was calibrated before and after each test, the conditions being the same as those which prevailed during the test; this was done because the platform in the mill on which the instruments were located vibrated slightly when all the heavy rolling-mill machinery was in operation.

The speed being known before and immediately after any pass, and all flywheel dimensions, the energy either given out or stored during that pass is readily determined from the formula



The Engineering Magazine

FIG. 5. DEVICE FOR CAUSING REVOLUTION RECORDS TO BE TRACED ON THE CHRONOGRAPH DRUM.

$$E = W_f \frac{V_1^2 - V_2^2}{2g}$$

in which

E=the energy in foot-pounds.

W_f=the effective weight of the flywheel which stores energy. In the case of these tests the weight of the rim plus one-third of the weight of the arms and the hub was taken as the effective weight of the flyweel.

V_1 & V_2=the velocities at the end or the beginning of a pass.

W in $\frac{W}{RL}$ may be written

$$W = [(E_c + \text{or} - E_f) - F]$$

in which

W=work in foot-pounds done during the pass.

E_c=foot-pounds of work done in the engine cylinder during the pass, determined in the usual manner from the indicator cards.

E_f=energy paid out or stored in the flywheel during the pass expressed in foot-pounds. This quantity is positive if the energy is paid out by the flywheel; negative, if it is stored in the flywheel.

F= the friction load at the proper speed expressed in foot-pounds; this quantity was determined from the indicator cards when the engine was driving the empty mill at constant speed.

"R" (reduction) and "L" (length) of the quantity

$$\frac{W}{RL}$$

pertain to the dimensions of the steel after the passes in question. If the original weight is known, and if further one of the quantities L or R is known, the other quantity can be readily computed. In these tests R is measured and L is figured. The greatest care was exercised in obtaining the correct figure for R. After all the rolls, including the finishing rolls, are set correctly, they remain thus under normal operating conditions. When a sufficient number of continuous-indicator cards, time- and chronograph-records had been taken, and without making any change whatever on the roll setting, enough billets were passed through the rolls to get the measurement for R for every pass. To explain more fully; in order to get R for the first pass, a billet was taken through the first pass, pulled aside, and permitted to cool; to obtain R for the second pass, a billet was sent through the first and the second passes; for R for the third pass, a billet was guided through the first three passes, etc. When thus a billet had been obtained for every pass, and when these billets had become cool, the width and thickness were carefully measured with micrometer calipers at anywhere from twenty to one hundred places, and the average of all these readings was taken in the determination of the areas. The difference between the areas of any two consecutive passes gives us R in square inches.

One objection to this method of obtaining R is the fact that the temperature of the hot steel may not be the same for like passes and on this account R may be greater or smaller than the R for the billet and pass for which the indicator- and time-measurements were made. This error, however, is considered insignificant, since under the conditions of operation it would be in the third or fourth decimal and therefore negligible.

From Figure 1 is evident both the manner of obtaining data and the electrical connections. Owing to the fact that no suitable storage batteries were at hand, the magnets on the instruments were replaced by others with greater current capacities and connection was made with suitable lamp-banks in series to a 220-volt circuit. The panel board had mounted upon it a small single-pole double-throw switch, P, the closing of which placed either the indicators II or, the chronograph C in circuit.

The chief-observer's station was on an elevated platform about fifteen feet in front of the rolls. About a minute before the test actually began, chronograph circuit D was closed, thus recording every one-half revolution of the engine. When the billet was brought to the mill, and perhaps five or ten seconds before it was entered, the chief observer indicated through the signal lamp S, to an assistant stationed at the engine cylinder, that the paper-moving devices of the indicators were to be put into operation. When the billet was beginning to enter the rolls, switch P was brought into instantaneous contact with B and was then at once thrown against A and held there until the end of the pass. The instantaneous contact with B marked on the chronograph sheet the beginning of the pass, while the contact of the switch with A closed the indicator circuit and thus caused the indicator diagrams to be traced. At the end of the pass, switch P was thrown against B again and returned with the greatest possible speed to A. Pulling the switch P away from A for a moment and returning it again caused a break of about a half an inch in the indicator diagrams, thus marking on the indicator cards the several passes and intervals. The chronograph gave the length of time of the intervals and passes; also, in addition, the revolutions in those periods, thus affording a check on the passes and intervals as marked on the indicator cards.

One objection which might be urged against obtaining the time-readings in this manner is that as a matter of course some small interval of time elapses in throwing the switch P. While this is true, it is likewise true that this small interval of time (not more than one-tenth of a second, perhaps), elapses with every throw of the switch and therefore the individual time determinations for passes and their intervals must be correct. These time determinations may of course occur one-tenth of a second after they actually took place, but since all records, including those for the indicator diagrams, are this much behind the actual instant of occurrence, this slight retardation in making the records introduces no errors.

Influence of Temperature in Rolling Steel and Pyrometers Suitable for Work Under Discussion.

The temperature existing during the rolling of the steel is of vital influence on the power required. This is of course so well-known that it could be passed over without comment. But since in these tests the temperatures of the hot steel were not measured at all, it is thought mention should be made of the reason why the taking of these important data was omitted.

At first it was intended to measure the temperatures during the different passes by means of an experimental thermo-couple, but this proved entirely unsuitable for the work at hand. As no other pyrometer could be secured it was necessary to make the experiments without such instruments.

From a study of the nature of the work and the surrounding conditions, it becomes evident that a pyrometer with a thermo-element is not suitable for the work at hand. An optical pyrometer alone can be used. The requirements to be fulfilled by an instrument which is to be used to determine the temperature of steel in rolling-mill work after every pass, are accuracy and rapid adjustment. It would also be of great advantage if the instrument were portable, but this is not absolutely necessary.

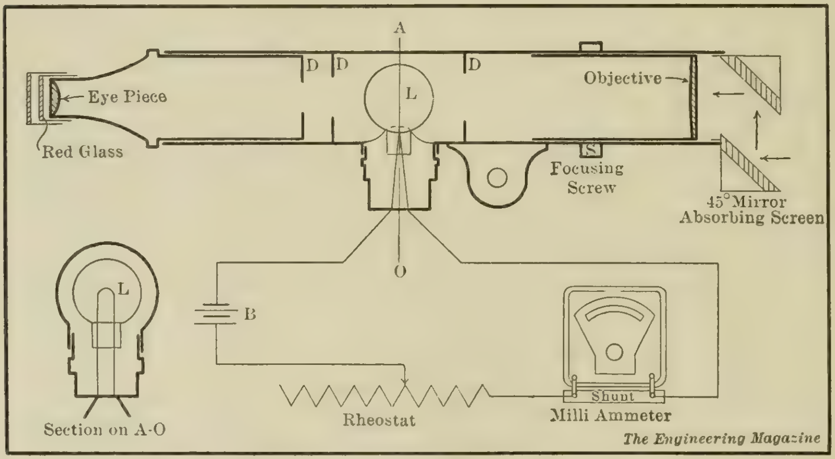


FIG. 7. HOLBURN-KURLBAUM OPTICAL PYROMETER.

The instrument which I consider excellently suited for this work is the Holburn-Kurlbaum optical pyrometer, a diagrammatic sketch of which is shown in Figure 7. It consists of a small 4-volt incandescent lamp, L, with hair-pin filament, and is mounted in the focal plane of the objective and of the eye-piece of a telescope provided with suitable stops, D, D, D, and with a focussing screw S for objective. The lamp-current is completed through a two-cell storage battery, B, a rheostat, and a milliammeter.

The determination of a temperature consists in focussing the instrument upon the incandescent object, thus bringing the image into the plane A C, and adjusting the current by means of the rheostat until the tip of the lamp filament disappears against the bright back-ground. From the reading of the milli-ammeter the temperature can be found from a previous calibration of the lamp giving the relations between the currents through it and the corresponding temperatures of a radiating black body. Each calibration is independent for different lamps used.

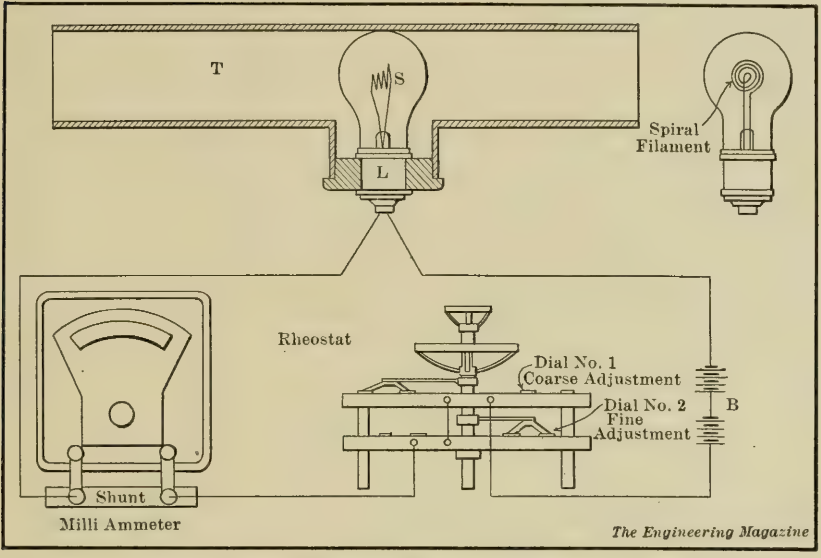


FIG. 8. MORSE THERMO-GAUGE.

The low limit for this instrument is 1,150 degrees F.; with a temperature of 1,500 degrees F. a red glass must be placed before the eye-piece to avoid the blinding effect of a brightness too great for the eye. This instrument is manufactured in Germany by Siemens & Halske.

Another instrument which might be used with equal success for the rapid determinations of temperatures of steel is the Morse Thermo-Gauge, manufactured by the Morse Thermo-Gauge Company. It is based on the same principle as the Holburn-Kurlbaum optical pyrometer, but owing to some slight difference in construction it is perhaps a little less sensitive. However, it may be read to within 5 degrees of the actual temperature, and this would of course be sufficiently accurate for the determination of temperatures in rolling-mill work. A diagrammatic sketch is given in Figure 8, the method of use will be shown in Figure 40.

To my knowledge the Wanner optical pyrometer has been used with success for temperature determinations in rolling-mill tests. One disadvantage of this instrument is that it can not be used below a temperature of 1,650 degrees F., and for the work in question this is a serious drawback. A sketch of the Wanner optical pyrometer is shown in Figure 9.

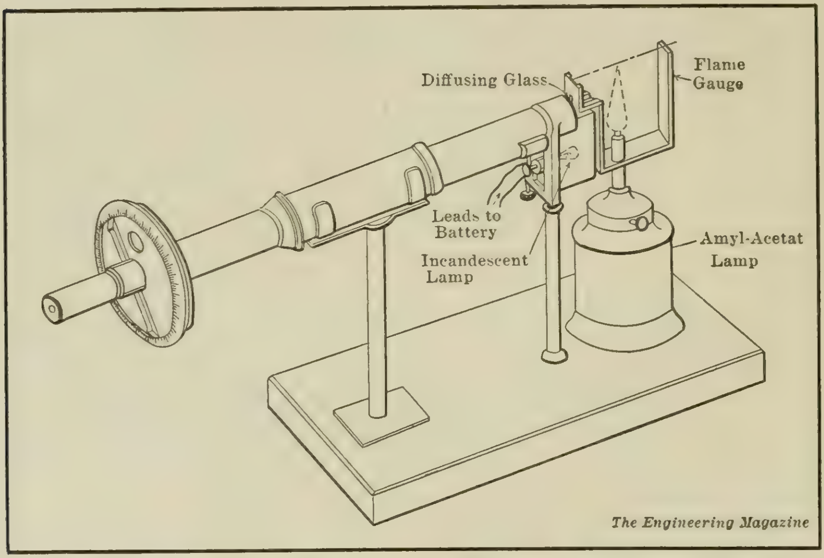


FIG. 9. WANNER OPTICAL PYROMETER IN POSITION FOR STANDARDIZING.

I know of a case where the Mésure and Nouel pyrometer telescope was to be used in accurate temperature determinations in rolling-mill tests. A section of the instrument is shown in Figure 10. This instrument has found its widest use in the ceramic industries; its lower limit is about 1,375 degrees F. While this pyrometer replaces the unaided eye to great advantage, it is not sufficiently sensitive for accurate temperature determinations in rolling-mill work. Without entering into a lengthy discription of the instrument, it is sufficient for the present purpose to state that even after considerable practice an observer can not be sure of his readings to better than 120 degrees F. at temperatures above 1,800 degrees F.

Considerable space has been devoted to the consideration of pyrometers useful for this work under discussion and we will now return to the subject we started out to discuss, *viz.*, the important part which the temperature of the steel plays in rolling mill work.

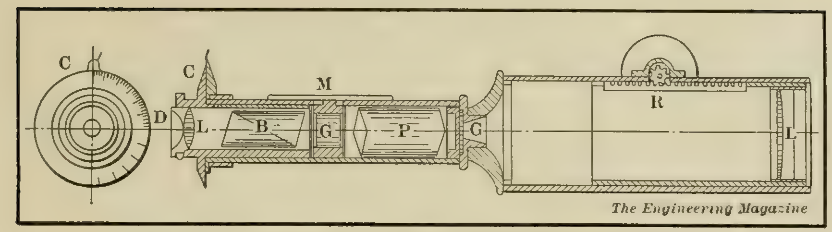


FIG. 10. MÉSURE AND NOUEL PYROMETRIC TELESCOPE.

From careful observation we soon learn that the greater the ratio of surface to sectional area, the greater will be the rate of cooling per certain time, and the greater will be the power requirement per given reduction. While my experiments were confined to comparatively thin plates, only I believe it to be a safe conclusion to state that the power required per square inch reduction per foot length of piece will be less in the case of a heavy ingot than is the energy required in the case of a comparatively thin plate, both rolled at the same temperature. I believe this to be due to the fact that while the surface temperatures as measured with an optical pyrometer may nominally be the same in both cases, yet the actual average temperatures would not prove to be the same if measurements could be made at different points across the section, as at a, b, c, d, in A, Figure 11, and at the points a, b, c, d, e, f, g, etc., in B, Figure 11.

By reason of the greater radiating surface per certain volume in A as compared with that of B, the temperature at the points a, b, c, d, etc., in A, would be practically that of the surface s, s, of that

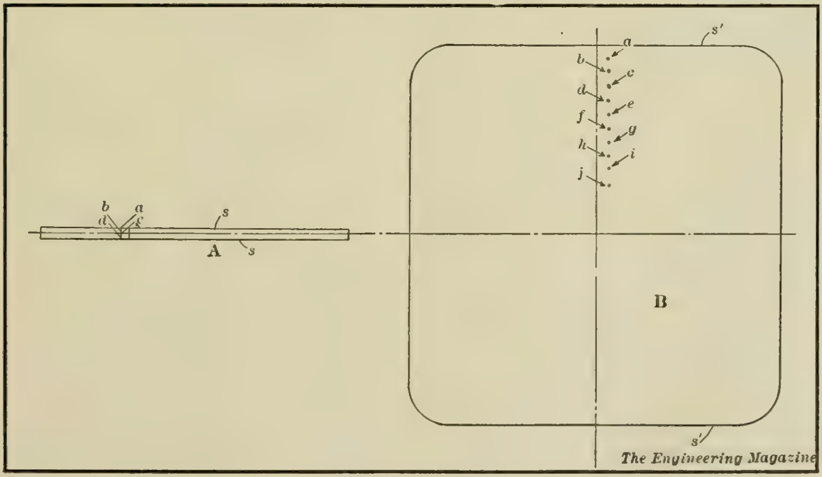
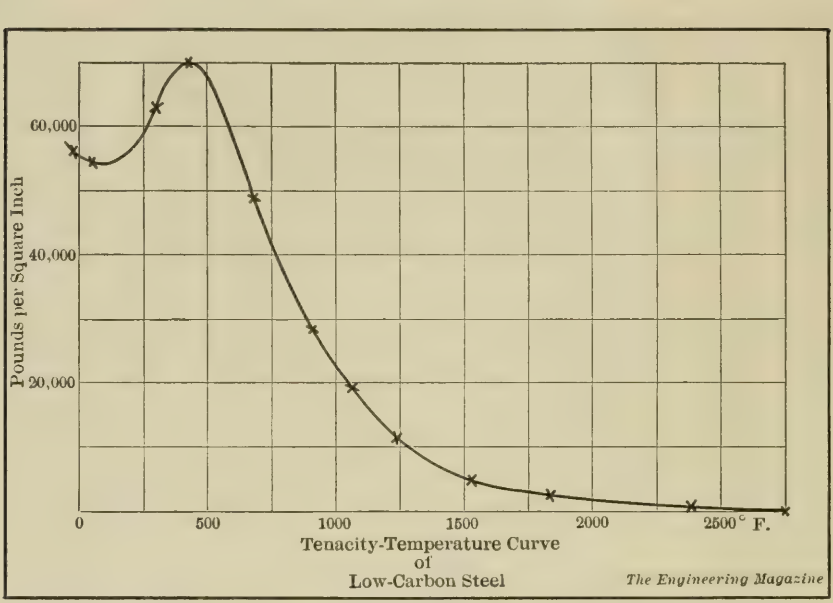


FIG. 11. SECTION OF STEEL BILLET ILLUSTRATING POINTS OF TEMPERATURE MEASUREMENT.



The Engineering Magazine

FIG. 12. TENACITY TEMPERATURE CURVE.

shape; while in B the points lying towards the center of the cross-section would have a considerably greater temperature than those in s, s. Therefore, since in measurements of steel temperatures with the optical pyrometer we speak of surface temperatures only, it is readily seen that at the same temperatures the power requirement per square inch reduction per foot length of piece would be greater in a section of the shape of A than in a section of the shape of B. For this reason it follows that if the power required for rolling a plate is to be determined, it would not be strictly correct to chose the Constant C curve of a heavy ingot.

In connection with subject under discussion the "Tenacity-Temperature Curve" in Figure 12 is also offered. Theoretically, in rolling hot steel the resistance offered by the steel against its permanent deformation, or what in our case is practically the same, *viz.*, the power required in rolling, changes in a manner similar to that in which the ultimate strength of steel changes at different temperatures. It is a known fact that the ultimate strength of the steel changes according to the temperature. It is generally known that if a piece of steel is heated its ultimate strength becomes less. In Figure 12 is shown this decrease of ultimate strength with increase of temperature. If we compare the curve in Figure 12 with the Constant C curves at the proper temperatures, mentioned later more in detail, we note a striking similarity in these curves. We would naturally expect this to be the case. The tenacity-temperature curve and the ideal Constant C curve would no doubt be closely parallel if it were possible to eliminate all irregularities due to the changing friction loads of the mill and the changes in loads due to roll-pass friction.

The conclusion of this paper, which will be published in the following (November) issue of THE ENGINEERING MAGAZINE, will present the results of the tests in a series of tables, followed by a discussion accompanied by curves and diagrams. To this will be added an analysis of the influence of the material and the size of the rolls upon the power required, and of the principles of design thus deduced. The last section of the paper deals with the cost of power in rolling mills, and with a comparison of the accuracies obtained in steam- and electric-driven mills respectively.

SYSTEMATIC FOUNDRY OPERATION AND FOUNDRY COSTS.

By C. E. Knoeppel.

I. THE TWO GREAT FORCES INVOLVED IN MANUFACTURING.

With this initial paper of a new series, Mr. Knoeppel returns to the study interrupted two years ago. The following articles will have the advantage not only of fully digested thought but of very valuable investigations and experience accumulated in the interim. While the first interest is the foundry, the principles and methods defined are equally applicable to the machine shop, the forge shop or smithy, and the structural steel works. Mr. Knoeppel's article next month will deal with the Principal Elements of Foundry Management and Accounting.—The Editors.

IN continuing the series of articles on the above subject, begun in the October, 1908, issue of this magazine, it might be well to outline the purpose of this second section. This will be to go into the details necessary to explain the practical side of foundry accounting and foundry operation, and to illustrate as far as possible the principles laid down in the preceding papers, which discussed:—

1. Foundry Accounting as a Problem.
2. The Importance of Correct Burden Apportionment.
3. The Elements Entering into Foundry Production Costs.
4. The Importance of Comparative Elements.
5. Treatment for the Various Classes of Foundries.
6. Foundry Organization and Management.

This series will take up the discussion of the two great forces which should be harmoniously united in every business—the "analytical" and the "constructive"; the principal elements entering into accounting and management; production and its details; labor costs; material costs; costing; statements, records and charts; predetermination of costs and the "efficiency movement."

It is extremely doubtful if the accountant of a hundred years ago would recognize the present-day accounting practice. He certainly would be in no position to appreciate immediately the progress that has been made since his day, owing perhaps to the fact that he would be lost in the maze of bound books, loose-leaf devices, card systems, mechanical aids, controlling accounts, short cuts, special rulings, billing machines, and a hundred and one other things which go to make our Twentieth Century accounting practice. He would admit, after he became familiar with the methods practiced, that wonderful progress had been made since his time; but he would also be impressed with the fact that many accounting schemes, considered excellent, seriously approach the "worth next to nothing" point.

There are a number of reasons for this. In many cases, the accounting is a mere jumble of figures, which have little or no value as a guide to the executive. In others, vital information is compiled only *once a year,* or if an attempt is made to furnish monthly statements, they are furnished so long after the close of a month, that the information contained in them represents so much waste effort—they are furnished too late to enable the executive to point out the reasons for certain inefficiencies. Then again, accounting schemes may furnish information without regard to the requirements of the business in question; or they may be changed materially from time to time, elaborated upon, "boiled down," new features added, others cut out—each new bookkeeper introducing a few "stunts" of his own, until he gets things to run his own way. Between all this and accounting schemes sold in "chunks," and further the willingness of each auditor or accountant that comes along to point out where the accounting fails to furnish the required data—where it violates the rules of standard accounting practice—the scheme in a short time becomes hopelessly confused, rendering intelligent comparison absolutely out of the question. Is it any wonder that a manufacturer, after going through such an experience, is far from being in a receptive attitude when "accounting system" is mentioned to him?

To present the right kind of information in the wrong manner is confusing and unsatisfactory. To present the wrong kind of information in the right manner is misleading and dangerous. It would be far better for many simply to keep track of the cash on hand and what is due and owing, than to maintain an elaborate accounting arrangement which does not result in an accounting that can be used in bettering the business. A scratch pad, a pencil, and a good guess would be just as efficient. The *right* kind of information, *rightly* presented, is therefore the problem.

As a declaration of principles, let us decide at the outset that an accounting scheme to be efficient must first of all consider the needs of the business in question; that it must be comprehensive, proceeding on the broad assumption that information should be given an opportunity of working for the executive—not a burial which may have no resurrection; that it must be designed to anticipate the needs of the executive in every possible way; that it must be planned not only to make possible a rapid comparison and analysis of the various elements, but to serve as a statistical bureau as well; that the accounting *must be simple* to admit of its being easily understood and quickly operated, in order that there may be no delay in getting the pertinent facts to the executive promptly; that it must be arranged so the unnecessary work and entries will be done away with, in addition to which it should be designed to furnish information *during* the month —a point of importance to every manager. Current information is of far greater value to an executive than data six to eight weeks old; furnishing figures of the latter sort is a fault which has done more to discredit modern accounting methods than perhaps any other one thing. The underlying thought should be not "what have we done" but "what have we done and what are we doing" from which an executive is in a position to answer "what can we do." At any rate, an accounting scheme which measures up to the above standard is entitled to consideration, for as a matter of fact, one of the possibilities in foundry accounting is *better and more complete information in quicker time and at less cost than is usually the case.*

There can be no question, however, if one stops to review the past, that there has been and is now, on the part of a great many, altogether too much dependence placed in mere cost records and figures; for while they are necessary and of the utmost importance, they must not be considered as being the only means to a desired end. A great many are satisfied when their cost figures inform them regarding the disposition of their money, in addition to which the figures may be used as a check on their selling prices. Others go a step further and use their information as a basis for comparison between operation and operation, or of completed unit with completed unit, in order to detect fluctuations in an endeavor to keep costs down. Others use their figures for carefully checking up the departments, foremen, machines, operations, men, etc., in order to reach some conclusion, even if not altogether accurate, as to the efficiency of their plant. Still others have definite estimates or standards against which the actual preformances are checked. How many are there, however, who use their facts and figures for all the purposes mentioned? As a matter of fact, if all were using all of them, they would be bringing into play what I have termed and defined in my preceding papers an "analytical force"—a process enabling them to apply remedies when their information developed the fact that certain places needed prompt attention.

An equally important force can be employed with as great if not greater results—on which can be fittingly termed a "constructive force," a building up process—which acting in harmony with the force just mentioned, finds ways and means to *anticipate* as far as is possible the leaks and faulty conditions. One force is as vital and necessary as the other, although it is true, and unfortunately so, that very few get all the good possible out of both of them. Whether employed separately or together, they are made up of the following steps:—

1.—Securing data.

2.—Recording the data secured.

3.—Compiling the data in convenient shape for reference and study.

4.—Reasoning applied to the compilations.

5.—Conclusions based on the reasoning.

6.—Action in some definite direction.

7.—Results.

The principal difference is that the analytical force is concerned with figures and statistics showing *what has been accomplished, as a guide to future action and results,* while the constructive force is concerned with facts and information as to equipment, conditions, operations, men, etc., showing *what should be accomplished in order to secure results.* One force will of course do a great deal of good without the other, perhaps because of the fact that there remains, in modern manufacturing practice, a great deal to be done, but it should be seen that the two forces mentioned, working harmoniously along widely different lines with the same goal in view, will accomplish more in the way of results than either of the forces working independently.

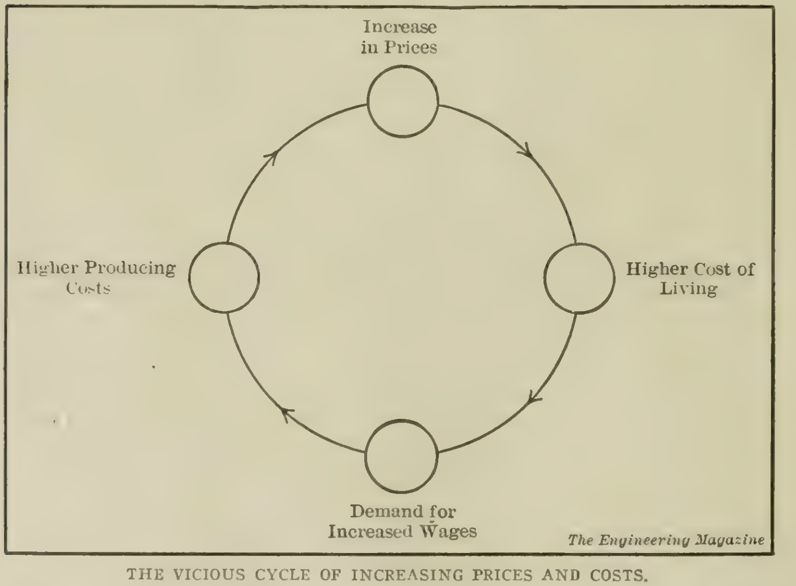
Mention was just made of the fact that a great deal remains to be done. How true this is no one knows better than those whose profession it is to assist in getting all that is possible out of men, equipment, and materials, and who are in a position to see, through close observation, where the faults lies and what will eliminate them. There is a task ahead of this great nation—a task so great as to warrant wise executives giving it earnest and careful consideration, as well as to attract the attention of those who are in a position through training and natural ability to assist in solving its many problems—*that of increasing the efficiency of all human endeavor.*

We have graft and investigations of one kind or another until it would seem that there remained no such thing as civic pride; we hear on all sides constant reference to "high cost of living" with innumerable reasons why; we hear that railroads must raise their rates in order to protect themselves, to which the shipper strenuously objects as any such increase affects cost of production which would mean still higher prices; we see sufficient evidence of a far from diminishing dissatisfaction among the laboring classes resulting in constant strife between capital and labor. These and many other conditions which could be mentioned furnish sufficient evidence that something is decidedly wrong—that we are face to face with conditions which cannot exist continuously without disastrous results.

This condition of affairs has been most excellently expressed by H. L. Gantt in his paper "Prices and Profits" which appeared in this magazine a short time ago:—

> With increase of prices comes higher cost of living; with higher cost of living comes demand for higher wages; with higher wages comes higher cost of production. Then to maintain the same profit under the new conditions, we must again increase our selling prices and the cycle repeats itself.

This vicious cycle is illustrated graphically by the chart below.



THE VICIOUS CYCLE OF INCREASING PRICES AND COSTS.

What is the trouble? To me, two great faults seem to be responsible: first, *extravagance* and second, *impatience.* The wide-spreading movement for the conservation of our natural resources is sufficient evidence that as a people we are extravagant, and no one, after due consideration, will deny the fact that in our hurry to get things done—to see results—to turn time and material into cash, impatience is largely responsible, both faults being the result of our present system of organization and management, as will be evident to anyone who will take the time to read carefully the series of papers by Harrington Emerson published currently in this magazine, on "The Twelve Principles of Efficiency."

As a people we have come to the national realization of the importance of conserving our natural resources, and as a result we now have this matter as one of our lively issues, forcing the attention of our able men. What we need, however, and *at once,* is a movement for the conservation of our resources other than water power, minerals, timber, etc., which would mean decided benefits. This would involve:

1.—Increased production.
2.—Lower production costs.
3.—Decrease in prices.
4.—Lower cost of living.
as an offset to the condition pictured in the chart.

What we need most of all is to hear more about *inefficiency* and less about efficiency. Most of us seem to like the latter word so well that we use it without much thought as to its real meaning. If we talk about the inefficiencies more, our efforts towards eliminating them will be increased, and efficiency, as a natural result, takes care of itself. Inefficiency is an unhealthy state of affairs—a disease in other words—just as susceptible to diagnosis and treatment as any unhealthy condition. If diagnosis and treatment are withheld, however, *decay and death is the result*—a law which is no different in its relation to the industrial body than to the physical body.

Efficiency in the best acceptance of the term means more than simply doing things well—I might say, *thinking* or *guessing* that they have been done well; it is the *positive relation or ratio* between a possible accomplishment—an ideal, a standard—with the actual attainment. We have had altogether too much imagined efficiency and not enough of the cold, mathematical, relative determination. The great trouble has been that standards have not been properly set, or if set no consistent effort is made to assist those responsible for results in attaining them. Consequently we have accomplishments that are not what they should be, which if reduced to a relative basis would show that inefficiencies are still "on the job." For this the management of the enterprise is largely to blame. Instead of beginning at the *bottom* and setting standards for each and every part of the work—whether it be operation or condition— entering into making a business successful, they begin at the *top* and fix in their own minds a final standard as regards what they *want* accomplished, after which they promptly proceed to unload all responsibility onto the shoulders of others—

everyone all along the line, down to the workers themselves, having a hazy idea as regards what is really expected of them; and as "anybody's task is nobody's work" it stands to reason that the final attainment cannot measure up to the expectation. This however does not seem to relieve those who have failed to accomplish what was wanted from their share in the session "behind closed doors."

In recent years, a great deal of attention has been devoted to "waste products"—a number of establishments having their own corps of experts, who do nothing but analyze and study the wastes previously considered as possessing little or no value, with the result that the markets today are filled with "by-products" of every kind and description producing a revenue which pays excellent dividends on the cost of their marketing.

In all industrial pursuits, there are many wastes which can be made to yield satisfactory returns. Careful investigation in the majority of institutions will soon develop the fact that the chief wastes are due to time losses, wasted materials, too much equipment, lack of intelligent planning, poor and insufficient facilities, equipment improperly maintained, etc. A costly bridge is erected, not because it was impossible to cross before but because crossing is facilitated and made easier with the bridge than without it, and as a result all share in the benefits. If, then, we place a force at work which will turn the wastes into products, we erect a structure which enables the consumer as well as the maker of the products to share in the benefits that always accrue through turning out more in less time.

This "constructive force" is one that is distinctly up to the management of an institution, and it might be well to outline in a brief, general way, what an organization should be and do in order to utilize the possibilities in the wastes.

A successful organization is one which considers the fact that this "constructive force" is a building force, and as it takes time to erect any structure, results must not be expected in a minute; that it should be composed of men who can give their time and attention to the careful study of the wastes, or be assisted by men who are expert in analyzing and bringing up for attention the weaknesses of the industrial body; that the hearty co-operation of the ones who own and operate the business is vital and necessary, in carrying to a successful issue the proposed ways to greater results. It should first see that the working conditions are what they should be; that the equipment is placed in the best possible shape for maximum production; that the men are furnished with the best facilities in order to enable them to take every advantage of the improved conditions and equipment; that the work, in its various details, is planned ahead and scheduled so that delays and annoyances can be eliminated; that careful observation is made as to time and materials consumed in order that suitable standards may be arrived at, against which accomplishment may be measured; that advice and instructions are given in order to assist the various persons interested in attaining the standards set; that suitable records are maintained in order that the management may know exactly what is being accomplished; that those who measure up to the expectations are rewarded in proportion as they assist in converting "waste products" into "by-products."

As will be easily seen, the above is not the usual procedure in the majority of enterprises. The usual course is to engage a manager; to allow him a limited time in which to get acquainted with the conditions and the product, and after that to tell him to go ahead and get results. His time is devoted to securing business; pushing the work through the shops—many times regardless of the cost; running a "diplomacy bureau" for the benefit of the customers; worrying about finances and getting customers to pay their bills; listening to complaints from his men; settling disputes and quarrels, and a thousand and one other things that an executive is called upon to do in the course of seven or eight hours daily. While so busily engaged, in spite of the fact that he may have facts and figures in abundance regarding what has been and is being done (which he uses as best he can when he has a little time), it is easy to appreciate how it is possible, in the absence of a well-organized attempt to convert wastes into cash, for time to be lost, money thrown away, materials scrapped, etc., all because industrial endeavor seems to be conducted on the assumption that the more detail a man can look after in the course of a day, the greater he is as an executive and the more he should be able to accomplish. As a matter of fact there is a limit to the amount of detail a man can handle, but *practically no limit to the supervision that an executive can exercise.*

Supply the executive with proper records and a staff of men who can assist him in locating and eliminating wastes and inefficiencies; make him a supervising agent, not a drudge; furnish him two good strong arms with which to work—one the "analytical force" with which he can study the past and present as a guide to the future—the other the "constructive force with which he can improve and build new structures, and the "By-Products Department" will pay dividends far in excess of the cost involved. Unless this is generally conceded to be the proper scheme of management—and not only conceded but *generally adopted*—we are going to have with us, as a destructive factor, the condition of affairs so clearly pictured in the chart.

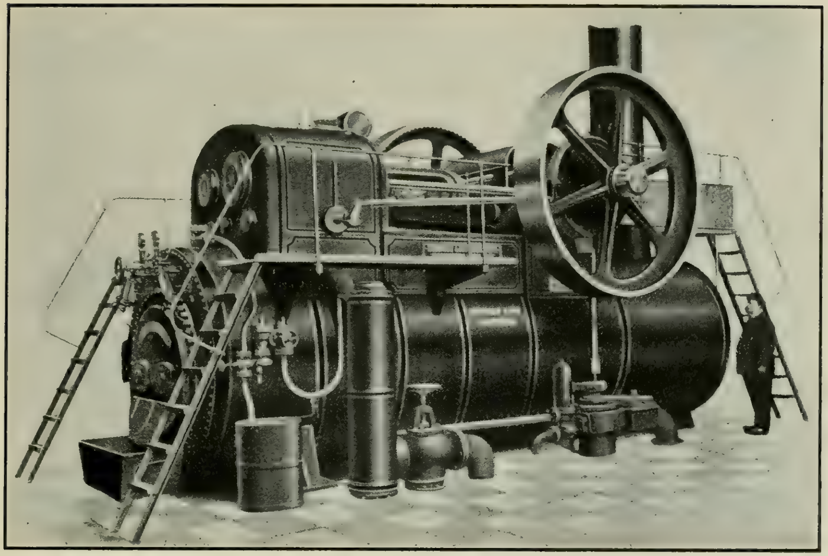
THE LOCOMOBILE OR SUPERHEATED-STEAM UNIT.

By Warren H. Miller.

Mr. Miller's article is the fruit of a recent visit to the Continent for investigation and study of mechanical developments. It is of much possible significance for owners or managers of isolated power plants of moderate size where fuel and water economy is of prime importance.—The Editors.

ONE of the striking things in the development of modern industrial Germany is the growth of the locomobile or superheated-steam unit, and this at a time when no further advances were looked for in the steam engine as a prime mover—except perhaps in the direction of the steam turbine. It is to the credit of the technical training of the German engineers of this generation that today there are over three thousand of these units in operation throughout Europe and Europe's trade dependencies, ranging in size 1,000 horse power down to 35 horse power, realizing an economy of 9.65 pounds of steam per hour per horse power, or 1.2 pounds of coal. Such radical improvements in steam economy in a unit of 100 horse power over the accepted regime of 30 to 60 pounds, as is usual in our plants—that is to say, 5 pounds of coal per horse-power hour on the power-plant coal accounts—are not obtained except by courageous putting into practice of all the things that scientific training shows to be possible in the generation of a horse power of work from the mineral coal.

Our own technical graduates have been taught, and know very well, that the losses in cylinder condensation amount to nearly 30 per cent with saturated steam, most of which can be eliminated by going to superheated steam; that the feed pump can and does waste nearly a fifth of the coal pile in getting water into the boiler; that the radiation from steam pipes, cylinder-walls, and boiler represents a loss of about 5 per cent of the coal burnt; and that, if you reduce the coal, all these losses, including the 20 per cent wasted up the stack, will drop accordingly. Yet, in actual practice, they are well content to design a 100 horse-power isolated station with a boiler room and engine room, steam feed pumps, ordinary low-pressure saturated steam, a high-speed engine of some 30-pounds steam economy, and a boiler which will deliver this steam at about 410

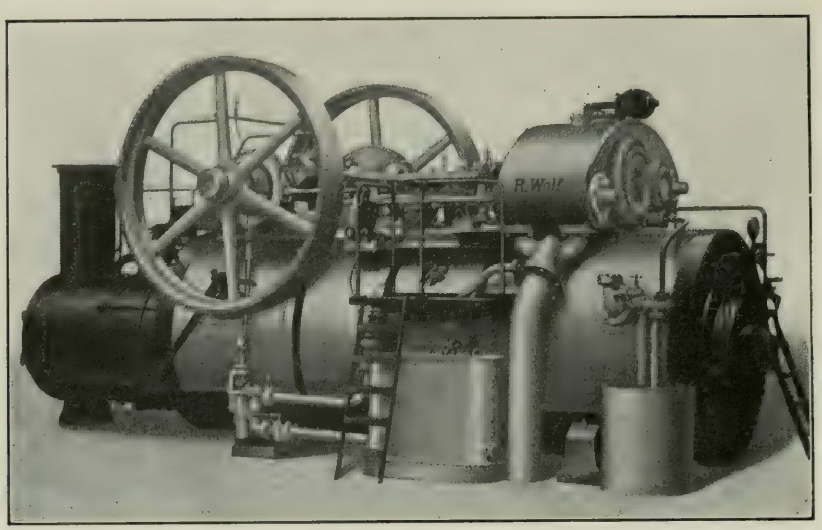


AN 800 HORSE-POWER LANZ LOCOMOBILE.

degrees F. stack temperature. Such a plant is considered a fair example of good steam engineering for small isolated stations—yet it is not the least, by far, among our numerous wastes of national resources.

For, if you study that plant from a purely scientific standpoint, you will at once perceive that, even at the outset, it is far below what is theoretically possible. And when you compare its four or five pounds of steam per hour coal consumption with the German one pound, and realize that its stack losses alone are equal to the whole German coal bill, it is evident that, practically, it is far below what is being done with thousands of German isolated plants of a similar character throughout Europe. At the Brussels World's Fair today the electric light and power for the whole exhibit is being furnished by a 1,000 horse-power Lanz locomobile superheated-steam unit, occupying a floor space of 25 by 35 feet, including the boiler, direct-connected to a dynamo on the boiler, and running in parallel with a 500 horse-power Wolf locomobile of similar design, neither of them using more than 10 pounds of steam per horse-power hour.

If we examine the American plant there are at once a number of obvious criticisms in the light of theory which will be readily granted. There is no superheating—therefore the boiler is too large by at least 50 per cent, because to provide enough steam at a con-



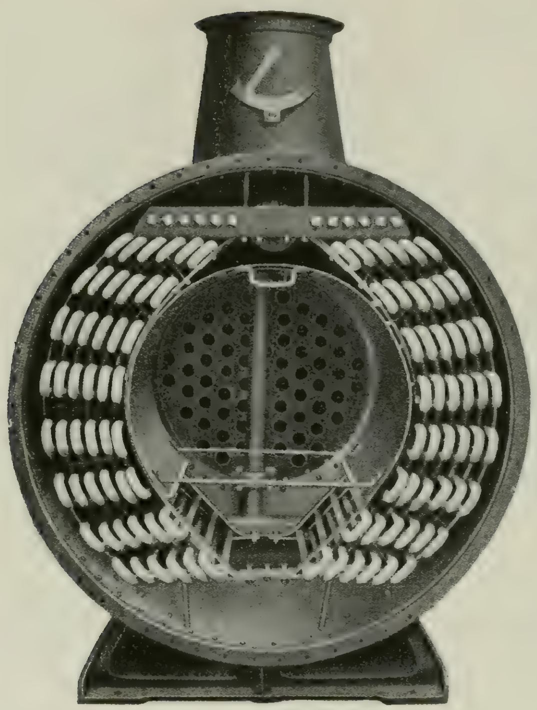
A WOLF LOCOMOBILE, 500 HORSE POWER.

version of 75 per cent to make up in power for the loss of 30 per cent in cylinder condensation the boiler itself has to be that much bigger. Another 10 per cent gets away in using steam at 110 pounds instead of 170, therefore the boiler is again too large by 15 per cent to allow for that; there is a loss of another 10 per cent due to absence of cylinder jacketting and the presence of steam piping, all of which has radiation and therefore wastes coal. Again the boiler is too large because the small duplex feed pumps, at 100 pounds of steam consumption, waste steam to about 15 per cent of the coal pile, whence the boiler is at least 25 per cent too large to provide for that. It is also too large because the waste gases go right up the stack instead of being used in superheating coils; and, being too large for all these causes combined, these waste gases are also far too large, as they represent 20 per cent of the coal, and the boiler must be therefore still 30 per cent larger to take care of *that* loss. Finally the floor-space and the building are too large, because the boiler is from twice to three times too big, and the engine might as well be mounted on the boiler, together with the dynamo, and house them all in one small building. The boiler being twice to three times too big, the radiation from it is also just that much too great, and, finally, the plant will not stay even at those figures, as it will scale. and there is no way to take out the furnace and tubes to clean them. The best that can be done is to soften the scale and send in a man with a compressed-air hammer to do what he can, and send a rattler through the tubes to clean them out.

And yet, if one examines the latest type of German superheated-steam unit, all these criticisms will be met with good working practical dispositions. You note that the key to the situation is the reaction of the economy of steam upon the boiler plant. If you cut down the steam consumption, the size of the boiler falls correspondingly, in the ratio of 1.3 to 1, and with it falls the loss up the stack and radiation and other absolute losses, dependent entirely upon the size of the boiler. If one succeeds in cutting the steam from 30 pounds to 10 pounds, the size of the boiler will be less than one-third and the stack losses alone of the large boiler will be three-fifths of the whole coal consumption of the smaller one.

This gain in steam consumption is worth any amount of careful study to obtain, and obviously the road to it lies in the direction of eliminating every possible loss in the steam *after* it is once made, in making it at the best temperature and pressure and in getting the feed-water into the boiler. The losses in the engine are due to cylinder condensation when wet steam is used; radiation from any and all systems of steam piping; radiation through heads and walls of cylinders; clearance waste; and the inability to use the waste flue gases in any way about the engine. Again, in the boiler, a study of our accepted designs will show that one has considerable freedom in the disposition that can be made of the hot fire gases before releasing them up the stack. The tubes can be made of such a length as to take out all the heat that is at all valuable from the gases, except that which is below 400 degrees and therefore of little value except to heat feed water in an economizer. One will then get the maximum evaporation of saturated steam at, say, 340 degrees or 110 pounds pressure.

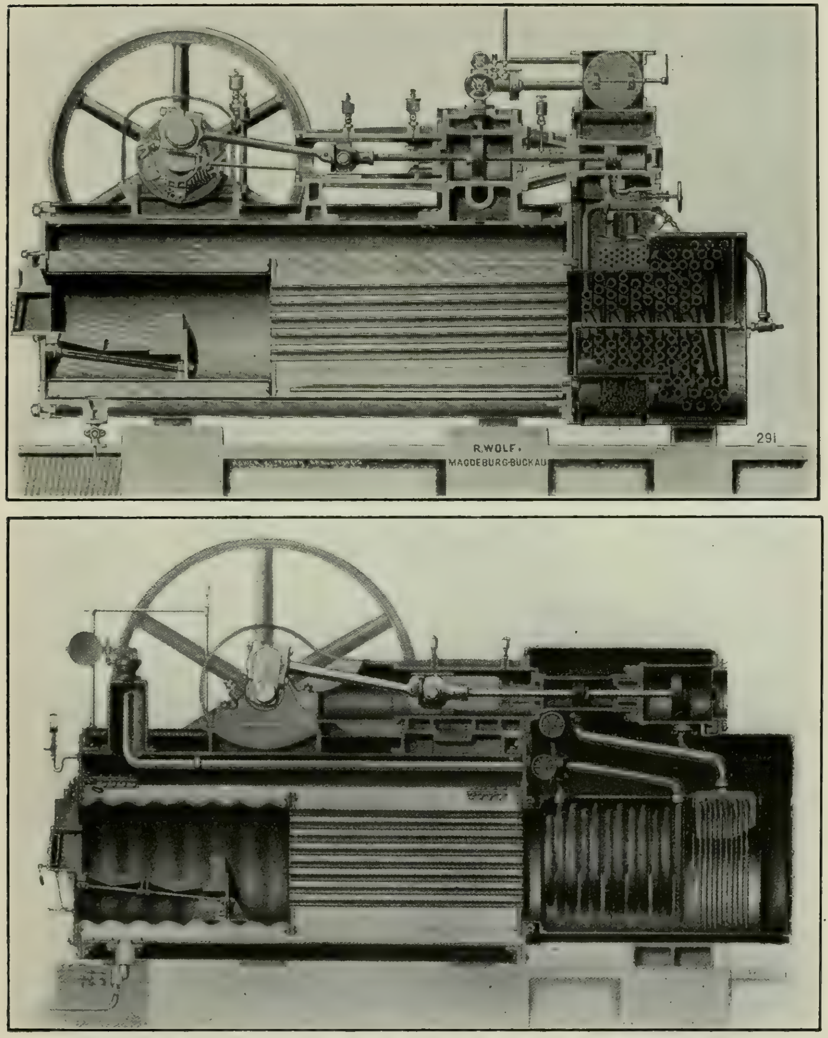
But, as the engine will gain 27 per cent in economy if the steam is superheated to 600 degrees F. and re-superheated again between high and the low-pressure cylinder, it seems at once advisable to design the boiler so as to pass the gases out of the tubes at somewhere about 700 degrees, using the rest of the shell to carry superheating coils. As further economy lies in getting as many expansions as is possible in two cylinders, it is also advisable to design the boiler for 170 pounds pressure instead of 110, which is generally carried in small plants. Then, as the temperature of the steam at the end of the high-pressure expansion will be about 230 degrees F., a second set of superheating coils can still be interposed in the path of the gases which will leave the first set at about 400 degrees. By passing this steam through the coils in a contrary direction to the



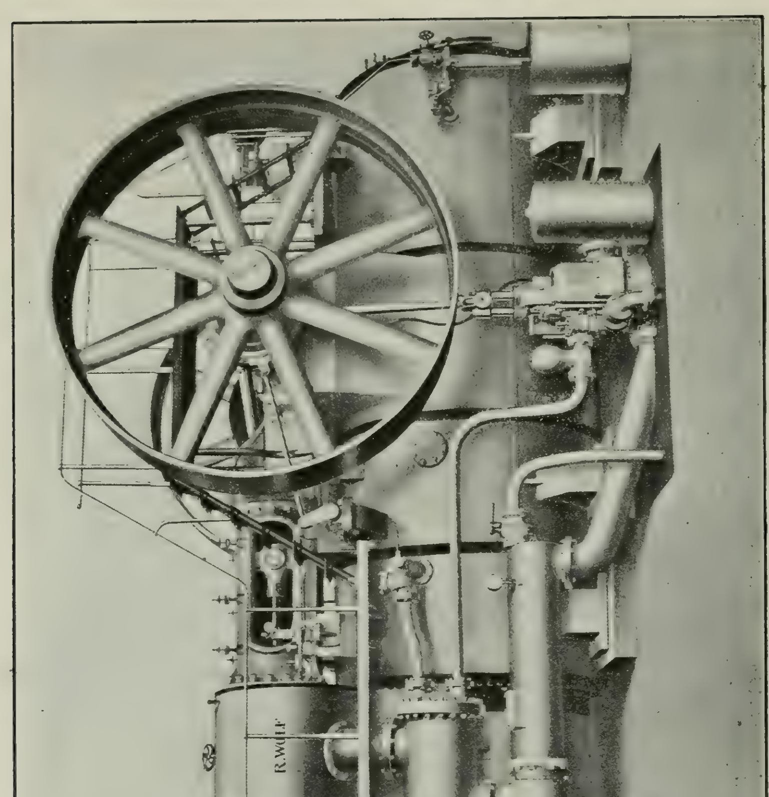
LANZ SUPERHEATED COILS.

flow of gases, it will arrive at the outlet to the low-pressure cylinder at about 360 degrees, the gases around that part of the coil being 400 degrees. At the stack end of this coil the gases need not be over 350 degrees to give heat to the entering steam at 230 degrees. A still further use of the gases would be to pass them over economizer coils in the stack, but, as the draught gets poor below 350 degrees, this is problematical and must be solved for special cases. These above arrangements have virtually eliminated cylinder-condensation in both high and low, besides which, as superheated steam at 600 degrees occupies a volume of 1.3 in proportion to the same unit weight of saturated steam, there is more absolute work in it, aside from elimination of cylinder-condensation.

To take care of the other losses, such as radiation and boiler feed, the sections of Wolf compound superheated-steam units on page 69 will show at a glance the dispositions. The high-pressure cylinder is mounted in the stack and the low in the steam dome. Both of them are thus jacketted, the low more effectually than the high as it is surrounded by comparatively hotter medium than the steam inside, but the high with stack temperature at 360 degrees has still a hotter medium than most of the expanding steam inside, in addition to taking out waste heat instead of live-steam heat as does the low. Mounting them both on the boiler shell not only makes the unit compact and gives a jacket to each cylinder, but it eliminates the lines of steam mains and engine taps always to be found in the ordinary small plant. These with their attendant leaks and radiation count no small item in the coal bill. In the locomobile unit all the piping is in the boiler shell except for the short lengths which rise to the cylinders; therefore, not only is radiation eliminated, but the pipes are virtually jacketted with hot flue gases. The large spiral tubes in the smoke box are the high-pressure superheater, and the small multiple tubes beyond the return in the smoke-box take care



LONGITUDINAL SECTIONS OF WOLF SUPERHEATED-STEAM LOCOMOBILES.



A WOLF SUPERHEATED-STEAM COMPOUND LOCOMOBILE UNIT.

of the exhaust of the high-pressure cylinder on its way to the low-pressure.

This type of engine secures the most advanced use of all the heat in the coal, to date, and with its economy of 8.65 pounds of steam per hour per horse power, or 1.04 pounds of coal, it crowds the gas-engine pretty closely. It is made by R. Wolf of Magdeburg-Buckau in sizes from 35 to 70 horse power.

In the larger sizes the design has up to the present taken the form of cross-compound engines with both cylinders mounted in the steam dome, that is cast in one piece with a cast-iron steam dome. Those made by the Wolf company run up to 500 horse power, and by the Lanz company of Mannheim up to 1,000 horse power. In order to get room on the boiler for large engines it is almost imperative to build them cross-compound, thus sacrificing a fraction of economy due to placing the horse-power cylinder in the smoke-box, but all the engines of this type do from 9 to 11 pounds of steam per brake horse-power hour or 1.30 pounds of coal.

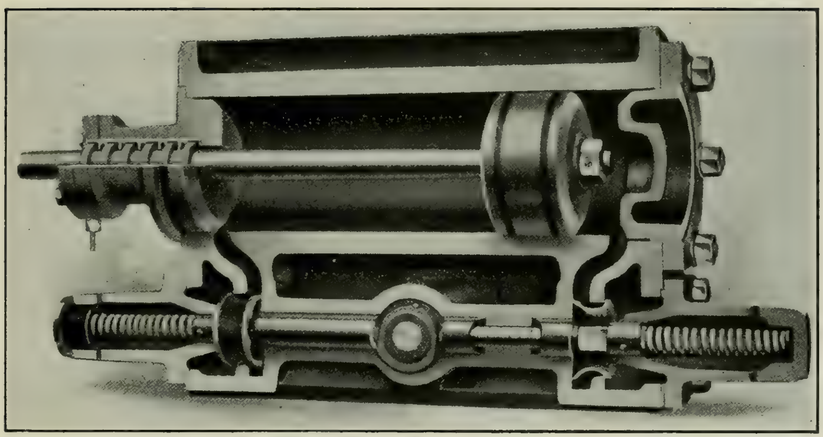
As might be expected, these advantages in the use of superheated steam were not obtained without a wrestle with the heat problems involved. No ordinary saturated-steam engine will run well on highly superheated steam, as the oiling of the distributing valve is somewhat difficult and the packing of valve rods and piston rods must also be done with metallic packing. In Germany they use a good deal of Schwalbe metallic packing for these engines and the Wolf company use light iron piston-valves in all their engines without having had any undue oil consumption or lubrication trouble reported against them.

But Heinrch Lanz of Mannheim has introduced the lift-valve system of steam distribution on his superheated-steam units, thus eliminating all lubrication, and has also adopted the scraped labyrinthine packing for valve rods, and return-steam packing on the piston rods. These arrangements have all become quite common on the various French, Belgian, and German large slow-speed steam engines using superheated steam and are mainly the outgrowth of deficiencies in ordinary steam-engine valves and packings when used with superheated steam. The lift valve is virtually the Stevens balanced ferry-boat engine valve, revived for use with high-heat steam for which it is excellently adapted. In the form of the "Lentz" system of valve-gear illustrated on page 73, it has been adopted by a number of the largest European engine builders, such as Krupp in Germany, Bollinckx in Belgium, and Tosi in Italy. It eliminates the dash-pot troubles experienced with the Corliss valve design; has a constant port opening at all loads; has no friction, and therefore requires no lubrication, so that the latter can be introduced by way of the piston-rod packing; and, being balanced, has but very little mechanical resistance. Its stem is thus made very small, and labyrinthine rings are turned on it, and the rod ground into the bore of the stuffing box. Practically no steam whatever then escapes around this rod, and it does not wear or require repacking as the travel is very small, being only 1-15 of the travel of a piston valve to give the same steam distribution. The labyrinthine packing of the piston rod utilizes the tendency of the exhaust vacuum to draw out condensed steam in the shape of water and oil emulsion from the rings of the labyrinth. There are a set of cast-iron piston rings, fitting lightly on the rod, and the chamber of each ring is filled with lubricating oil under pressure and condensed steam water which soon fills all this space. Helped by the oil pressure and the vacuum during half the travel of the rod, the steam of each stroke returns as water during the exhaust without ever penetrating much beyond the third cast-iron ring.

Aside from these details there is little that is mechanically needful to arrange when using superheated steam. It is not advisable to use brass or copper piping as both weaken considerably at temperatures above 500 degrees. The total expansions from cold engine in the frame are taken up with suitable adjustments of the clearance. The engine frames themselves are of the "open" type, oiled with cups and wipers instead of splash-oiling. Going at 200 to 250 revolutions per minute they give long and efficient service, and the angular variation is as little as any of the heavily totally-enclosed splash-oiled engines of this speed. The tachometer on the 1,000 horse-power locomobile at the Brussels Exposition shows a very steady angular speed, well within the requirements for good parallel operation of alternates on 60-cycle current.

To conclude with the use of steam in a locomobile the following cycle is followed:—The steam enters the engine at 170 pounds pressure and 625 degrees F. superheat; it expands down to 234 degrees in the high-pressure cylinder; is again superheated to 361 degrees and then expands down to 90 degrees in the low-pressure cylinder whence it rejects into the condenser, which is usually of the jet type and mounted on the unit.

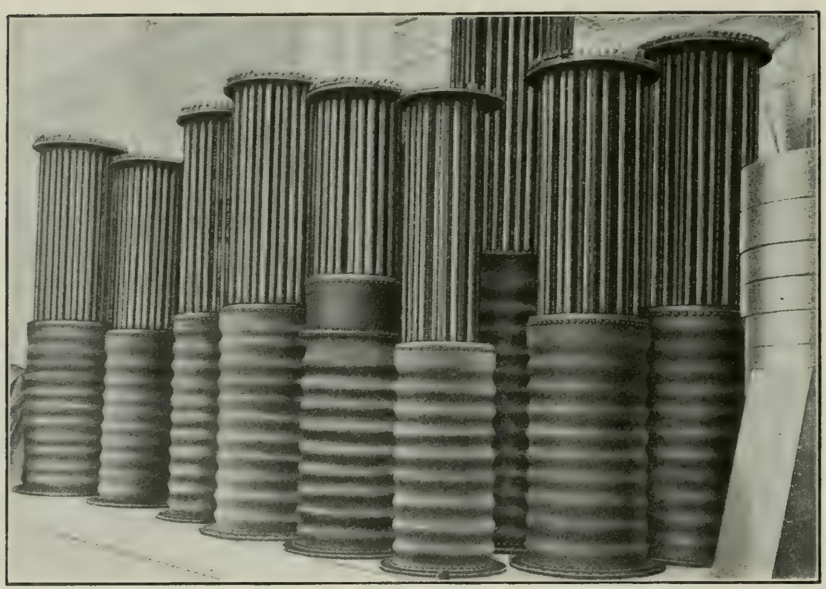
As regards the important matter of mechanical accessories, the first thing to examine is the boiler feed. In a small 100-kilowatt



THE LENTZ SYSTEM OF VALVE GEAR.

plant this is usually furnished by two small duplex pumps, one of which is either running all the time slowly, or else standing idle dripping steam water and run fast at periodic intervals. In either case it must deliver about 5,000 pounds of water per hour into the boiler and will itself consume steam to the amount of 100 pounds of steam per horse-power hour. The actual horse power it will expend will amount to 4 if continuously running to feed 5,000 pounds into the boiler at 170 pounds. This will then be 400 pounds of water consumed by the pump, not counting drip losses. As the main engine uses 3,500 pounds of steam, the feed pump uses 1-8 of the total coal pile, or, on the basis of 1,000 pounds for the total steam consumption for a superheated steam-unit of 100 horse power, it would use up nearly half of the total coal. Wherefore the Germans invariably have this feed pump mechanically-driven by an eccentric and sheave on the main engine shaft, with an injector as a standby. The same thing is done and for the same reason with the air and condenser pump, in a jet condenser, are of course combined in one. But when the unit is driving a dynamo, and electric power is available both from the dynamo and from the city reserve, the Lanz company add a motor-driven condenser pump, which has the advantage of being able to start ahead of the main engine and thus avoid the steam escape attendant upon starting with dry condenser.

Up to last year all locomobiles were used to drive dynamos by belts off the flywheels, but, in the most recent engines, the waste and annoyance of this drive have been eliminated by mounting the dynamo also on the boiler shell, using its rotor as one of the main



FURNACES AND TUBES FOR SUPERHEATED-STEAM LOCOMOBILES.

flywheels. This has turned out entirely feasible in practice, and constitutes a great saving in floor space and friction.

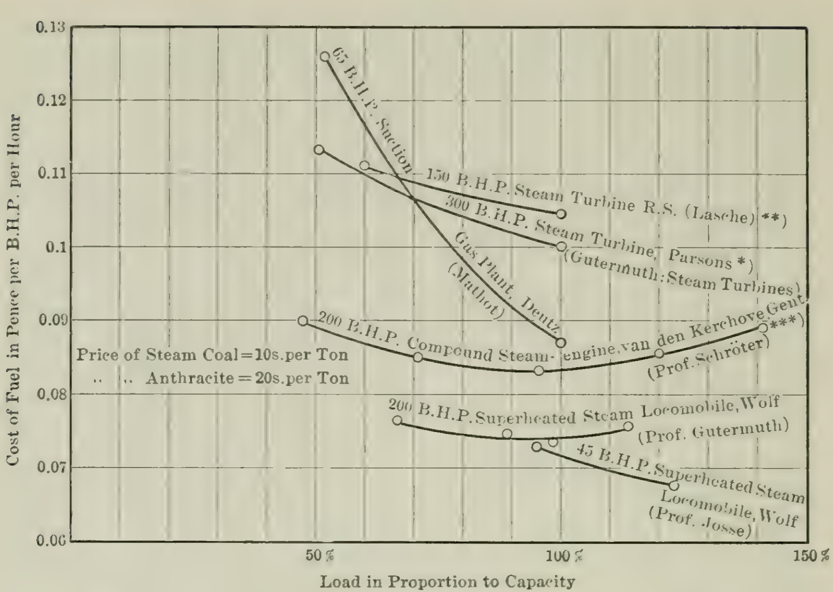
Another mentionable accessory is the very complete system of automatic stokers and low-heat-grade fuel feeders studied out for all sizes of locomobiles. As might be expected the grate is surprisingly small. For a 250 horse-power unit, instead of an 8 by 7-foot grate as is usual with our 250 horse-power boilers, the grate is not more than 4 by 3 feet for good coals. Having this small requirement to work from, it has been easy to design large grates for exceedingly low-value fuels, without getting into special outside furnaces or other structural troubles. All are internally fired in standard marine corrugated furnaces, and the grades of low-value fuels burnt cover wood, shavings, dross lignite, bagasse, corn husks, earthy coal-dust, coffee-husks, sawdust, and straw. It thus gives the locomobile a wide adaptability for isolated stations, so that it is not surprising to find them in the cane-brakes of Cuba, the plantations of Portuguese East Africa, or the pampas of Argentina. Naturally they follow the European trade lines. One of the largest of these over-sea installations is the 2,400-kilowatt central electric plant at Concepcion, Chile, comprising three 800 horse-power locomobiles, or *mi-fixes* as the French call them, put in by the French branch of the Wolf company.

To clean the furnace and tubes the forward tube sheet is bolted to the inside of the head with stud-bolts and cement, and the entire rear head is bolted to the flange on the shell. One can thus take the boiler apart and pull out the corrugated furnace and tubes in one piece, making it easy to clean thoroughly and also to get at the inside of the boiler shell. Our "conservatism" would doubtless land heavily on this sensible scheme, in the shape of getting adequate boiler insurance, but, there it is, used universally throughout Europe, and quite as safe as the bolted heads of a large steam cylinder. The superheater coils can be blown out in place by suitable hand-holes in the smoke box, and, by taking out the return-gas shell, all the coils can be reached for hand cleaning.

The heating of feed water is obtained by a tubular feed-water heater, mounted on the boiler shell and taking the exhaust steam from the low-pressure cylinder immediately after exhaust on its way to the jet condenser. If the water is of good quality it is taken from the overflow of the jet condenser by the feed pump and forced through the feed-water heater on its way to the boiler. A feed temperature of about 170 degrees F. is thus obtained.

The engine governor in all makes of locomobiles is of the flywheel type, advancing or retarding the throw of the eccentric which operates the piston or lift valves. These latter are actuated by a cam containing a large circle of maximum lift; by advancing or retarding the throw of the eccentric, the time in which this circle is in contact with the valve-stem is varied, thus giving a constant opening of the lift-valve which is variable only in the amount of time that it remains open. Having a very light friction, a combination of flywheel and spring, reacting against themselves to control the opening of the centrifugal weights which shift the eccentric, can be used, thus giving immediate and sensitive governing.

A final word as to buildings. The furnace being small and usually automatic, and the boiler having moving machinery mounted on it, it is easy and advisable to keep the entire equipment clean, so that instead of the dusty and ashy boiler-room so common in our own plants, the locomobile units generally look like a new pin, with all bright-work polished and carpet runways in the engine-room and on the platforms. With a downdraft smoke flue leading to the chimney outside, a complete electric generating station can be put up that will be clean and stay so, and that can be housed in a single small building of some simple and ornamental architectural design that will be



*) Steam Pressure : 183 lbs. per sq. in. Temperature 250°C,
**) Steam Pressure : 176 lbs. per sq. in. Superheat, good Vacuum
***) Steam Pressure : 132 lbs. per sq. in. Temperature 300°C, Vacuum: 27.6 in.
} Efficiency of Boiler Taken at 0.7

The Engineering Magazine

COMPARATIVE EFFICIENCY TESTS OF STEAM AND GAS UNITS.

a pride to the operatives and an incentive to keep it the best-run plant in the neighborhood.

To sum up for the remarkable economy of the superheated-steam unit:—By reducing the steam consumption from 30 pounds to 10 pounds the boiler size drops to one-third. By thus reducing the absolute stack loss and eliminating the steam feed-pump, the necessary capacity of the boiler is still further reduced; so that to produce the same energy in mechanical work, the coal actually expended is only one-fourth of what is used in an ordinary steam plant.

THE TWELVE PRINCIPLES OF EFFICIENCY.

By Harrington Emerson.

V. THE THIRD PRINCIPLE : COMPETENT COUNSEL.

Mr. Emerson's current series began in our June issue. The introductory article was a brilliant demonstration, from historic examples, of the power of certain principles of efficiency. His second paper showed the unsuitability of the ordinary organization for the introduction of these efficiency principles, and indicated the nature of the changes necessary to permit their application. In our August number he reached the "Twelve Principles" themselves, and took up the first—"Clearly Defined Ideals," following this in September with the "Second Principle—Common Sense." The wide applicability of the Principles to diagnosis or betterment of efficiency conditions in all sorts of industrial situations is suggested by the collateral papers following Mr. Emerson's article this month.—THE EDITORS.

WHEN I was a boy, hobnobbing with British boys in various parts of Europe, we relied on the manly art of self-defense, and I was expected to hold my own, by my two fists, backed up by my own courage. We loathed the *savate* dexterity of the French boy, the knife play of the Italian boy, the stone-wrapped-in-handkerchief sling of the German boy, for we considered such methods of defense and offense not according to the rules of the game. Nevertheless a well directed kick in the stomach from a French boy stopped very effectually my onward rush, and a slash from a pocket knife in the hands of an hysterical Italian boy, a leather belt loaded with a heavy brass buckle and murderously swung by a German boy, and other similar experiences taught me that bare fists, a stout heart, and supreme contempt both of the personality and ethics of an antagonist, were not sufficient to insure even an honorable truce, much less victory; so I compromised by carrying a club cane which I had feloniously poached from a king's preserve, the irregularity of acquirement adding a sentimental value to the weapon.

The early American manufacturer, generally of British blood, relied also on his own skill and knowledge. He was a practical man, and if a blacksmith, iron was iron and his own skill mastered the material; if a cabinet maker, wood was wood, not a veneered and inlaid concoction, and his own skill mastered the materials. These early leaders scorned the thought that they needed lawyer, purchasing agent, accountant, bouncer, private detective, doctor, chemist, or standard-practice engineer to help them run their shops and business.

They believed in themselves as much as their contemporary in the presidential chair, Andrew Jackson, believed in himself. It has been only by slow and reluctant steps that great American executives, heads of large corporations, have acquiesced in the innovation of specially qualified advisors. The change has come too fast, for there are men—Andrew Carnegie, James J. Hill, John D. Rockefeller—who have not only witnessed the change from the simple to the complex, but who have themselves been the mightiest human element in bringing about the change. Human industrial giants, who know as to the whole scope so much more about a business than any late arrival of a specialist, may well be excused for impatience and scepticism too often fully justified.

A great president of a transcontinental railroad was troubled by the flooding and washing away of his line on the slope of a foot hill. His engineers recommended relocation of the line at a cost of $800,000. The old eagle called for an Irish roadmaster and contractor; out they sped in the president's special, and for a whole day they tramped the situation.

Following their conference and decisions, wing ditches were dug so as to divert the surface water around the hill and away from the road bed, the remedy costing $800 and proving a complete success.

Another railroad president asked his engineering department to estimate the cost of grading a road in Texas. The estimate based on experience elsewhere was $800 a mile. The veteran president, a frontiersman from birth, called in a bright division superintendent and asked him if he could grade the extension for $450 a mile. Committed to the superintendent it actually cost $435. The water chemist to the same president strongly advocated a treating plant at a certain well. The president demurred because it was not at that point that water gave trouble. The chemist insisted that the water showed more grains of incrusting matter than at any other point. The president secured from another official a table showing the number of locomotives taking water at each of the tanks and found, as he expected, that very few watered at the bad tank, very many at the good tank, whose water, only containing half the grains of solid matter, deposited ten times as much in the boilers because twenty times as much was used.

Many of the older executives must today not only fulfil their own duties but in addition see that the inexperienced one-sided specialists do not cause more trouble than they cure. Nevertheless, best practice in any line depends today on such a vast range of experience and knowledge that no one man, even in a very limited field, can master it all. No modern captain has a pilot's license for all harbors, and the wiser the captain, the larger the vessel he commands, the more willing and anxious he is to depend on local knowledge, even if the expert be an Arab, a Malay, a Kanaka, a Maori, or an Eskimo.

The trouble with the water-purifying chemist was that he was too inexperienced, too limited to pass on the whole subject. His opinion was valuable and sufficient as to the grains of solid in each water and at that he ought to have stopped.

Competent counsel cannot come from one man. All around us are the laws of the universe, here and there partly read and codified, but with many great and partially traversed regions. Counsel, direct or indirect, is wanted from each man who knows the most, so that we may not be floundering along on last week's, last month's, last year's, last decade's, or last century's knowledge, but use special knowledge, today the possession of the few, but destined to become world practice.

High-speed steel was made known to the world by Messrs. Taylor and White in 1900. In 1903 one of the great western railroad shops was still without it; in 1910 another railroad shop in the Eastern States, was discovered taking 18 hours to turn a pair of locomotive drivers, 3 hours being ample time on the type of lathe used. There are facts about high-speed steel, the dimple of durability, for instance, as yet known only to the few.

In striving for industrial efficiency of operation, we have made pleas for a different type of organization—the defensive, constructive organization instead of the offensive, destructive organization; we have made a plea for definite high ideals instead of indefinite low ideals; we have made a plea for supernal common sense instead of near common sense; but no radical change in either point of view or practice is needed to extend the use of competent counsel from legal, accounting, purchasing, engineering, and other departments to an efficiency department.

The legal counselor of a great corporation is often a vice-president, the purchasing agent is often a vice-president, the chief engineer is often a vice-president, but the efficiency counselor is often a subordinate far down the line attached more by accident than design to some special department.

The legal counselor extends his warning, helping, guiding hand to every other department. "You may not do this because it is illegal; there is reasonable doubt as to another action; there is no doubt as to another plan." He does not pass on finances, records, engineering, or efficiency questions. The financial counselor stands against irregular expeditures however much needed; the purchasing agent buys what is requisitioned in the best and most advantageous market.

In the vanishing era of elementary achievement, efficiency mattered not, but legality did; therefore long ago lawyers were consulted. Efficiency did not matter in the building of the pyramids, but engineering did; and from that time to this the engineer has been supreme in his own department. If it were not for the lawyer passing on charters, titles, agreements, there could be no railroad; if it were not for the financiers raising sums far beyond the power of even the richest individual there could be no railroad; if it were not for the engineer who designs the machinery that produces steel, who designs cars and rails, bridges, turntables, locomotives, there would be no railroad; if it were not for the traffic manager the rails would rust, the cars stand empty; were it not for the operating executives, there would be collisions and disasters.

But the railroads and industrial plants almost without exception are operating without efficiency counsel, efficiency problems of momentous import being decided off-hand, by intuition. Is it to be concluded that efficiency is of minor importance?

At the present moment the business of the country is disturbed, shippers are arrayed against railroads and railroads against shippers; railroad employees are being urged to act as a voting unit against any one who favors legislative interference with railroad operation. Because it is not competently advised from the efficiency standpoint, the Interstate Commerce Commission prescribes monstrously difficult, even impossible standards, brushing aside the accumulated wisdom and experience of the Master Car Builders' Association. Because they are not competently advised by efficiency counsel, shippers fight any rate increase, unable to point out wherein it is unreasonable, the fact being that many present rates are too low and others too high. Because they are not competently advised as to the economies in operation and maintenance that would flow from efficiency, the railroads overlook the great gain within their grasp while they pursue the much smaller gain from greater rates they may not succeed in securing.

The total annual salary and labor bill of the railroads of the United States in 1908 was $1,035,437,528. It is probably 15 per cent higher for 1910. There is an impressive appearance of accuracy in these figures from which we are pained to miss the odd cents, but an examination of the sub-divisions shows that the average equivalent obtained is not quite 80 per cent, that a preventable waste occurred of over $200,000,000.

In contemplating this enormous waste, the accuracy of expenditure statement loses its impressiveness, and side by side with these valuable and accurate figures of the expert accountant, we would like to see other figures from the efficiency counselor—other figures of far greater practical import.

The other annual bills for operating expenses were, in 1908, $653,780,115, of which about $500,000,000 was for material. Is the efficiency of material used more than 60 per cent? Wherever it has been carefully and scientifically checked, in railroad operation, efficiency has scarcely reached 40 per cent.

The cost of all railroads and equipment is reported for 1909 at $14,514,822,308. Interest at 6 per cent and average depreciation of 4 per cent (which is low) gives an hourly charge of $165,694 for these two items. An increased use of 4 per cent would amount to a gain of this amount each day, or over $50,000,000 a year. As the net earnings of the railroads in 1909, including sinking funds, were only $1,078,132,735, the railroads were about $400,000,000 short of earning 6 per cent plus depreciation, but sympathy is not as great as it would be if it were not so evident that wastes were annually occurring, a very large part of them preventable and aggregating a sum larger than net earnings.

What the railroads have not yet realized is that natural expenses are progressing geometrically and revenues are only increasing arithmetically. For a time heavier locomotives, larger cars, lessened grades, longer trains, counteracted the geometrical danger, and it is doubtful whether highest efficiency will provide all the remedy needed, whether competent counsel of the highest order will not become imperative. The primary question, however, is not whether inefficiency costs the railroads $100,000,000 or $1,000,000,000 a year; but the question is why either loss should occur, and whether it is not sufficient to warrant competent counsel.

The legal counselor does not, cannot know all the laws and proper legal formalities in every State, and he therefore employs junior and often senior counsel. Similarly a counselor as to efficiency would not pretend to be an expert as to all efficiency, but it would be his duty to be in touch both as to men and scientific reports with all that was latest and best and make it all available for his employer whether individual or corporation.

If the corporation were large it would be the duty of the efficiency counselor to install and develop an efficiency organization, extending from top to bottom even as the accounting department extends from top to bottom. Each minor official would have his own staff of efficiency experts working directly for him, but also even as the timekeeper to a superintendent is subject to the comptroller, so also would each efficiency expert be subject to the direction of the efficiency officer above him.

The chief efficiency counselor would initially advise as to type of organization; he would ascertain what the ideals were and strive for their realization; he would represent supernal common sense; but it is chiefly as to the standardizing of the other operative principles that his organizing ability would be applied. In most operating plants both discipline and fair deal are defective, records are neither reliable, immediate nor adequate, despatching is so elementary as scarcely to be beyond the stage of putting into the shop an order for work, there are few, if any, scientifically made work schedules, there are no standard-practice instructions, no standardized conditions, no standardized operations and efficiency rewards are defective.

Competent counsel must permeate every efficient organization, and if competent counsel cannot be carried into operation, it is because the organization is defective, because some staff is lacking, and the staff that usually still awaits creation is the efficiency staff.

In coal mining in the United States the question is not whether 5 per cent or 3 per cent of the miners are killed each year, it is not the question whether we kill more or less than England kills, but the question is why a smaller per cent obtains in the more dangerous and difficult Belgian mines.

A cholera epidemic is now raging in Europe. It is particularly bad in Russia, and is making headway in Italy. Several times in the last few years Germany has been infected, but each time competent counsel has prescribed procedure which has stamped out the disease, even measures advised and enforced by competent counsel have stamped out yellow fever on the Isthmus of Panama.

In chemistry more advance has been made in ten years than in all the previous time; metallurgy, fifteen years ago was in its infancy. A generation ago a hospital was a charnel house and a doctor a peripatetic disseminator of contagion and infection. A generation ago sailing vessels were the rule and ocean steamers the exception, and farming had advanced only one step beyond the Egyptian or Assyrian methods. All this gigantic betterment has come because there was competent counsel, so competent counsel well deserves to be one of the Twelve Principles of Efficiency, and nowhere else is competent counsel more needed than in the application of the eleven other principles.

Practically there is close analogy between other competent counsel and competent efficiency counsel.

SMOKE PREVENTION AND THE EFFICIENCY OF FIREMEN. A CONCRETE INSTANCE.

By J. A. Switzer.

Professor Switzer's short paper, contributed independently, is presented in close association with Mr. Emerson's fifth article as an illustration of practical efficiency following application of the principles of "Competent Counsel," or expert advice, and standard-practice instructions.—THE EDITORS.

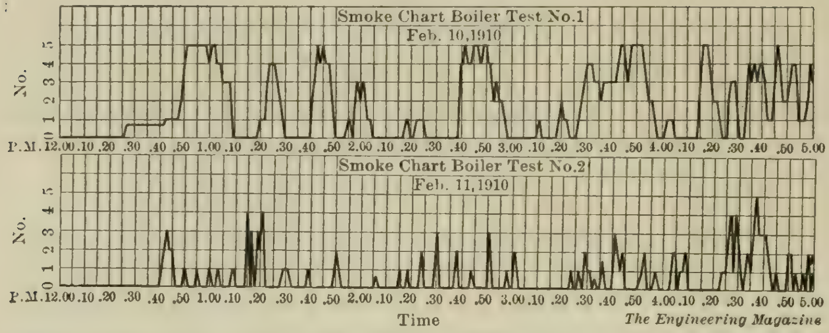
THE superintendent of one of the largest cotton mills in the Southern States, a man who takes great pride in the equipment of his million-dollar plant, recently installed in his power house No. 2 a battery of four Scotch marine boilers equipped with Hawley down-draft furnaces. In selecting this type of furnace he had been influenced not a little by the claim of the makers that it lent itself particularly well to the combustion of low grades of soft coal without smoke.

Notwithstanding a visit of a week's duration from an expert fireman, sent by the makers to instruct the resident fireman, the plant was a prodigious smoker. This condition being naturally very obnoxious to the superintendent, and the statement having been made by the Department of Mechanical Engineering of the University of Tennessee that, in the judgment of its professors, an abatement of the smoke was not only possible but would prove a measure of economy as well, a request was sent to the University to make such tests as were needful to substantiate their claim.

Accordingly two tests on successive days were made by the Department of Experimental Engineering; the observers employed on the tests were students in the senior class in mechanical engineering in the University, and they were under the constant surveillance of the writer.

The equipment of the plant was as follows: four 200 horse-power Continental boilers of the Morrison Scotch marine type, served with Hawley down-draft furnaces; a Gleaner feed-water heater; a Green fuel economizer. Draft was natural, being obtained by a chimney 152 feet in height. The power required of the plant being between 600 and 700 horse power, but three boilers were in service.

Throughout the first test the fireman handled his furnaces in the manner to which he was accustomed, having been told simply that the conduct of the test was not to interfere with the regular service. His



The Engineering Magazine

SMOKE CHART WITH INEFFICIENT FIRING (UPPER SCALE) AND WITH EFFICIENT FIRING (LOWER SCALE).

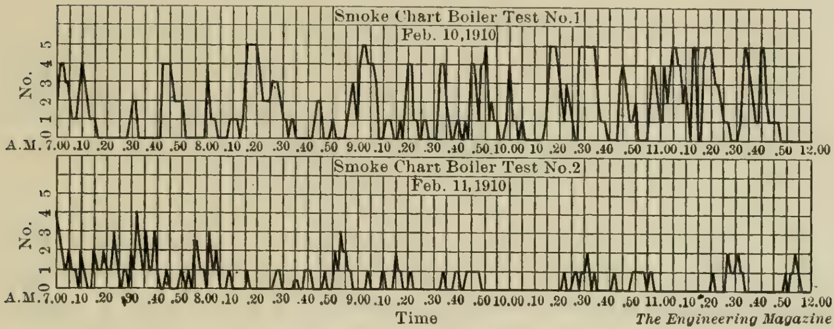
method was to fire at comparatively long intervals, to fire large quantities of coal at a time, and frequently to "understoke," that is, to fire green coal upon the under grates. He explained to the writer that "owing to the heavy demand made upon the boilers, steam could not be held without resort to under-stoking." Throughout the test smoke observations were made by continuous comparison of the smoke issuing from the stack with the Ringelmann chart. The trial was conducted in accordance with the code of the American Society of Mechanical Engineers, by the alternative method.

The day of the second trial chanced to be stormy, and was so dark that the lighting load was carried nearly all day, thus increasing the load on the boilers. The load during the first day was 647 boiler horse power; during the second, 690.

For the second trial a different fireman was employed, and his handling of the fires was directed and closely watched by myself. Coal was fired frequently and in small quantities; no green coal was fired upon the under grates, and the slice bar was used with caution in order not to shake down from the upper grates any coal from which the volatile matter had not been distilled.

Due precaution was taken to avoid prejudice on the part of the smoke observers in favor of the second day's record; and as no watch was kept of the graphical log, no notion of the relative boiler performances was had during the progress of the test. Except, indeed, that it was evident even to the coal heavers that less coal was being used the second day, we were in the dark as to the showing we should make.

A very casual comparison of the two smoke charts here shown will make evident the lessening in smoke production that was accomplished; combustion the second day was so nearly smokeless that the



The Engineering Magazine

SMOKE CHART WITH INEFFICIENT FIRING (UPPER SCALE) AND WITH EFFICIENT FIRING (LOWER SCALE).

requirements of the most drastic smoke ordinance existing anywhere would have been met. Even more striking however is the comparison of the two boiler performances. To set these forth clearly the principal data secured are here shown in parallel columns:

	First trial.	Second trial.
Duration of trial, hours	11	11
Steam gauge, pounds	136	133.2
Draft gauge, inches of water	0.447	0.419
Temperature flue gas (before passing economizer) degrees	480	448
Temperature flue gas (after passing economizer) degrees	353	336
Heat value of coal, B. t. u.	13,234	13,017
Total coal consumed, pounds	27,015	25,418
Total refuse, per cent	12.7	11.4
Per cent CO_2 in flue gas	7.34	7.50
Total Weight apparent evaporation, pounds	234,586	249,934
Equivalent evaporation per pound of fuel, from and at 212 degrees	9.22	10.9
Equivalent evaporation per pound combustible, from and at 212 degrees	10.54	12.2
Boiler horse power (31½ pounds equivalent evaporation per hour)	647	690
Efficiency of boiler and grate, per cent	67.5	81.0

The saving in fuel is thus seen to be approximately 25 per cent, and figured on a basis of 650 horse power for 312 working days per year and counting the cost of coal at $1.50 per ton, this represents an annual cash saving of $1,544.

Could a better argument for the employment of really intelligent men in boiler rooms be found? How often one finds power plants wherein the engine room gives asylum to a high-grade man, while apparently it is assumed that the ability to heave coal—and plenty of it—is a sufficient endowment for the boiler-room attendant!

REDUCING THE COSTS OF ENGINE BUILDING BY EFFICIENCY METHODS.

By Wm. O. Webber.

IN the course of practical experience some years ago, with efficiency methods applied to the manufacture of steam engines, I obtained and recorded certain results which are epitomized in the schedules and comment presented on the following pages. For the sake of brevity the tables are confined to two typical examples, each representing lots consisting of twenty engines. In the first of these tables it is apparent that the average reduction in total cost was over 9 per cent. The second and third tables show that the reduced cost of manufacture was secured by a lower expenditure per hour and in spite of the use of actually more hours put upon the work. The last table reduces the construction time to a percentage basis showing that over 11 per cent more time was put upon the second lot of engines than upon the first.

This additional time represented additional care, finish, and quality. The prices paid for all machine labor were identically the same in both cases. The lowered total cost per hour consumed was due largely to better facilities for doing the work (such as improved jigs and other devices) and to better and more immediate and reliable records, which made the costs attainable within a few hours of the completion of the job. The extra time put upon the later lots represented more really serviceable work; for example, the lower slides were made adjustable as well as the upper slides, and a number of features of this class were introduced, making the product a better engine in every way. The tabulated results are as follows:

Size.			Per Cent.	
8 by 12	$537.57	$485.45	90.4	9.1 gain.
9 “ 12	617.05	561.42	91.0	
10 “ 12	655.71	592.25	90.4	
10 “ 15	684.84	610.62	89.1	
11 “ 15	761.25	695.85	91.2	
12 “ 16	889.00	807.40	90.9	
13 “ 16	906.00	826.70	91.2	
14 “ 16	1070.00	999.78	93.0	

8)7272

90.9 per cent average.

COMPARATIVE COSTS IN CENTS PER HOUR.

Size.	Hours.				
8 by 12........	2,405	divided by	$537.57	21.2	cents per hour first engines.
9 “ 12........	2,813	“ “	617.05	20.9	
10 “ 12........	3,090	“ “	655.71	21.2	
10 “ 15........	3,365.5	“ “	684.84	20.2	
11 “ 15........	3,674	“ “	761.25	20.8	
12 “ 16........	4,250	“ “	889.00	20.9	
13 “ 16........	4,530	“ “	906.00	20.	
14 “ 16........	5,050	“ “	1070.00	20.8	
				20.75	average per hour first engines.

Size.	Hours.				
8 by 12........	2,776	divided by	$485.45	17.5	cents per hour later engines.
9 “ 12........	3,185	“ “	561.82	17.6	
10 “ 12........	3,426	“ “	592.25	17.3	
10 “ 15........	3,570	“ “	610.62	17.1	
11 “ 15........	4,021	“ “	695.85	17.4	
12 “ 16........	4,707	“ “	807.40	17.1	
13 “ 16........	4,728	“ “	826.70	17.5	
14 “ 16........	5,510	“ “	999.78	17.2	
				17.34	average per hour later engines

RELATIVE TIME PUT UPON THE WORK.

Size.	Hours.	Hours.	Per Cent.	
8 by 12........	2,405	2,776	15	per cent more time used in construction of later engines.
9 “ 12........	2,813	3,182.5	13.4	
10 “ 12........	3,000	3,426.5	11.	
10 “ 15........	3,365.5	3,570.5	06.	
11 “ 15........	3,674	4,021.5	09.5	
12 “ 16........	4,250	4,500	06.	
13 “ 16........	4,530	4,728.5	04.5	
14 “ 16........	5,050	5,350	06.	
			11.4	average do.

The methods followed, as identified and classified by Harrington Emerson's "Twelve Principles of Efficiency," may be briefly described:

FACILITIES.—It is very evident that it was a waste of time to put the bed of an engine upon the planer simply for the sake of planing the lower guides, especially as a jig had to be used centering one end by the journals, and the other end by a trunnion put through the stuffing-box hole and kept absolutely square and level with the journal jig. Furthermore, there was no opportunity of taking up any wear which might eventually occur in the lower slide, and as the engine ran over and generally in a forward direction, a large part of the wear would occur on this lower slide. It was therefore determined to avoid putting the bed on the planer at all by casting a recess where the guide should go, planing the lower guide separately (as the upper one was planed), then putting it into position on the erecting floor, leveling it up with the jig, and babbiting it in position at the same time that the journal boxes were babbitted and the jig originally put in position. This transferred the work on the lower slide more to the erecting floor, and avoided planing the bed at all, but of course put more work on the smaller planer on which the slides were planed. Another change was made by which brasses were milled on the milling machine instead of being planed on a planer, a jig being provided which cut all the brasses in a string and milled the two opposite sides with end millers at the same time. The brasses were then one-quarter turned in unison and the end millers did the same work on the other two sides.

A still further change was the milling of steam-chest covers on a jig which milled both sides of the cover at the same time with end mills in a similar manner.

A still further change was made in supplying cylinders to the erecting floor with the heads ground in, the studs all in place, and the jacket fitted on by a gang of men cheaper than the ordinary erecting men, who kept ahead of the erecting gang and had at least fifty cylinders of different sizes fitted up.

Better and More Immediate and Reliable Records.—In this case the records were immediately gone over, and if any particular work was excessive, for instance the planer work on the 10 by 12 engines or the shaper work on the 12 by 16 engines in the list given last August*, an inquiry was at once instituted to find out why this planer work was higher than either of the next smaller or next larger engines, and the trouble was traced to its source. This was sometimes found to be an error in keeping the records; sometimes the men, in putting in their time slips (which they did every night), charged the job up to the wrong set of engines; sometimes, getting broken up on their job, they had to replace jigs unnecessarily; sometimes the trouble came from defects caused by the foundry, such as a new moulder put on any given job keeping his sand too wet, causing all the castings made by this new moulder at first to be too hard, thus taking up a great deal more time in the machine shop.

It is obvious in the case of the shaper time that the jobs were charged to one lot of engines; in the planer time, where the additional cost is only about 10 per cent of the average, the reason is more difficult to find, with the exception that the job might have been broken up. It requires a good deal of moral courage on the part of a superintendent, when the office is clamoring for a certain size of engine, to prevent such additional cost, but I have invariably found that it was expensive to break up an operation or a job in order to expedite the completion of any particular lot or size of engines.

---

* The Engineering Magazine, August, 1910, page 730. "Costs of Machine-Tool Operations in Steam-Engine Manufacturing."

It is obvious even to the uninitiated that if all of the machine-tool operators were working on the same lot of engines at the same time, they were much less liable to error in making out their time slips each night than they would be if two different lots of the same size engines were in the machine tools at the same time. For instance, it would be easy enough to keep the parts for a lot of 10 by 12 engines distinct from the parts of a lot of 12 by 16 engines, but if two different lots of 10 by 12 engines were in the machine tools at the same time, it was often difficult to keep, say, lot 122 separate from lot 128.

Premium Work.—As a specific instance of premium work at the Blank Car Wheel Works, we paid $1.80 for 12 blocks fitted into tyres per day; this was at the rate of 15 cents per block. I offered the man $2 for 13 blocks per day, which is at the rate of 15.4 per block; he jumped at the proposal, and as soon as he became expert at that, I offered him $2.50 per day for 15 blocks per day, which is 16 2/3 cents per block. This he thought was very liberal, but we had increased our output 25 per cent, and although this was an increase of 39 per cent in wages, yet it had the effect of increasing the output of the factory 25 per cent at no extra general cost.

Discipline.—I remember on first going to the Blank Iron Works the men were allowed to smoke when they were working, at any time of the day, and when a man was sent on an errand from one department of the factory to another he always improved the opportunity of getting a smoke. I put a stop to this by requiring the men to stay in their own departments, and if a message or request had to be sent from one department to another it was sent through the foreman by the usual requisition blank; the letter-carrier boy who went round once every half-hour delivering mail and messages. Smoking was forbidden during working hours, excepting that a man was allowed to finish his pipe in the morning directly after the whistle blew at 7 o'clock; he was then prohibited from smoking again until the noon hour, when if he smoked he was required to do so in the blacksmith shop, but given permission to finish out his pipe when the whistle blew at 12.30. There were no printed or written rules about this thing, or in fact about anything, but the unwritten laws of the shop were thoroughly understood and strictly enforced.

Another instance of discipline was forbidding the men to congregate at the grindstone ostensibly to sharpen their tools, but also for the purpose of gossiping. This we stopped by taking out all the grind-stones in the factory, requiring every tool worker to go to the tool room and get a sharp well dressed tool; this he was allowed to keen up on a water grinder, several of which were installed at short distances around the shop. At first this created a great deal of opposition, as no workman wants another to sharpen a tool for him. As soon, however, as the work was largely piece work, and the operators had begun to realize the benefit of certain standard shop methods and forms, they readily accepted the tools as they were furnished from the tool room, and the water grinder was used only for such actual "keening of the edge" as was absolutely necessary to expedite the work. Piece work also prevented any idling or gossiping at the water grinder, as nobody wanted to idle his time when it meant dollars and cents to him.

Fair Deal.—From an inner and personal knowledge of the different processes and methods of doing work, I am sure it is very essential to evolve properly a system of piece and premium work. This also means to evolve properly a system which shall be fair to employer and employee. It seems to me that it is absolutely necessary for the man directly in charge of the men, the superintendent, or whatever may be his title, to be absolutely fair to either party, and so much so that it is recognized by all of the men that he is absolutely fair—the minute that this attitude is changed and the feeling is engendered that he is trying to beat them down to the lowest notch possible in all of their efforts, the usefulness and influence of the superintendent is largely gone.

Probably the best work that I have ever read to properly equip myself for such a position is Charles Read's novel "Put Yourself in His Place" which has to deal with the cutlery makers in England something like one hundred years ago. Probably no book ever written made so strong an impression upon me as the one quoted, which I read some forty years ago when at the machinist trade myself. So strong was the impression made at that time that I resolved if I ever got into a position of authority I would endeavor to be absolutely fair with myself, the employer, and the employee. It is absolutely necessary to have such an attitude in order to be in the slightest manner successful in the handling of a large body of workmen. They certainly are no fools, and it is a great mistake ever to assume that they will be for any length of time. There probably have been no wiser words ever written than those of the immotral Lincoln:

"You can fool some of the people all the time and you can fool all of the people some of the time, but you cannot fool all of the people all of the time."

EDITORIAL COMMENT

The Problem of the Terminal.

THE opening of the eastern link of the Pennsylvania tunnels, from the New York Terminal to the Long Island connections, has attracted attention anew to this remarkable undertaking and its significance from various points of view. Financially, it is gigantic; technically, a subject of deeply interesting study and observation, past and future; economically, a perplexity—a plunge of magnificent proportions and doubtful expediency. The magnificence, however, is for the present dazzling, while the wisdom or unwisdom remains to be proved.

So far as the Pennsylvania Railroad alone is concerned, some apparent facts are that the serious and burdensome factor of expense of the terminal division will be hugely increased. The costly structures in New York, with all their appurtenances, will not displace nor materially relieve the maintenance of the Jersey City Station, the ferries, and the subordinate terminals on the Manhattan side of the rivers. So far as passenger movement is diverted from Cortlandt, Desbrosses, or 23d street, to the new Terminal, however, the effects on city conditions will be distressing rather than otherwise. They will be an impairment of the present fairly good distribution of travel among centers well equipped with branching local transportation lines, and delivery of more or less of this travel, thus diverted, at a point at present conspicuously deficient in distribution facilities, and able to secure them only with the almost inevitable result of discharging its stream through what is already one of the most congested foci of Greater New York—Herald Square.

Practical demonstration during the first few days of use seems to suggest that travel will be reluctant to concentrate at the new Terminal, preferring to continue the use of facilities which, though older and slower in actual time of transit between termini, yet reach delivery points nearer to the passengers' objective. The problem of congestion may not become acute simply because travel will not throng to the Terminal so long as the ferries remain open. This, however, while palliative of anticipated evils, would not be a happy vindication of the Terminal's existence. And so far as the Terminal does attract any dense condensation of passenger movement toward Herald Square, it will be the negation of the influence so much needed in solution of the problems of traffic in a great city. The need, as lately defined by one of our leading contributers, is "to secure distribution, to scatter foci, to relieve congestion." The Terminal contracts distribution, creates foci, causes congestion.

"Tonnage Mania."

THE great terminal seems to be a product of the tonnage mania so searchingly criticised by Harrington Emerson in our August issue. The American imagination falls readily captive to the idea of size. Huge locomotive units, huge train units, huge steamship units—why not huge terminal units? The connection with economic results—with unit efficiency in performing a unit of work—is almost or quite overlooked. Indeed, American railroad magnates have seldom been great economists, even seldomer great psychologists. Had they been the former, railroad finances would now be in far sounder condition, far less dependent on the uncertainties of an effort to increase carrying charges. Had they been the latter, they would not have alienated popular sympathy by petty autocracy toward passengers, exasperating indifference toward individual shippers, double dealing with legislatures and with the public.

Even now, as one of the ablest financial reviews has lately pointed out, their capacity for wrong-headed action is showing itself by lack of frankness in meeting the Interstate Commerce Commission's investigation of rates, and by lack of wisdom in needlessly curtailing maintenance expenditures for the sake of producing an artificial deepening of the current industrial depression. The policy deceives nobody, while it offends many. It is pointedly illuminated by Judge Gary's statement just given out "that if the railroads were buying up to their necessities, the mills would be crowded." Of foolish legislation there is enough and to spare, and the railroads have suffered much from it; but childish conduct on their part will not effect a cure, nor improve their position.

Industrial Engineering.

IT is not always easy to recognize the character or tendency of a process of evolution going on immediately under our eyes, and for this reason, perhaps, the technical world was slow to realize and to acknowledge that the requirements of modern manufacturing were calling into existence a new department of engineering, specialized, and distinct from any of the branches of the profession generally recognized up to say about ten years ago. It was slow to realize that organized manufacturing was inherently and necessarily an engineering proposition which should be committed to and managed by engineers, and it is only within a comparatively short time that industrial engineering has gained anything like an acknowledged standing.

The creation of this new sphere of technically trained activity shows many points of similarity to developments that have been observed elsewhere in the past—that is, it is an instance of applied science following the creation or the evolution of a new art or occupation for mankind. Such an instance might be found in the case of navigation. When travel oversea became more than an incident of exploration or adventure —when commerce required the ministry of staunch and safe vehicles moving with reasonable regularity and certainty—the science of navigation was developed to conserve and promote the art of seamanship. It has drawn upon older and purer science—upon astronomy, upon meteorology, upon hydrography, but out of its more elementary components it has fused a distinctive body of science of its own.

Again, with the introduction and use of the steam engine and of machinery, mechanical engineering arose to the dignity of a characteristic applied science, drawing upon chemistry, upon physics, upon mechanics (all older and purer sciences) and yet out of these elementary components forming its own characteristic body. An analogy to this same process seems to appear in the case of industrial engineering, but the movement is so comparatively young that the distinctive character of this science (as already said) has been but impartially and sometimes grudgingly acknowledged. It is often supposed, or assumed, that industrial engineering is merely a province or an application of mechanical engineering. Industrial engineering does, indeed, draw upon mechanical engineering in something the same way that mechanical engineering drew upon physics, or navigation drew upon astronomy for a part of its foundations; but yet the province of industrial engineering is distinctively different from that in which the mechanical engineer has long been established.

Indeed, the industrial engineer may have in his organization staff many mechanical engineers superintending special departments—design or construction, or the power-plant, for instance—while his own duty is to co-ordinate all these factors and many more for the one great central purpose of efficient and economical production. He is concerned not only with the direction of the great sources of power in nature, but with the direction of these forces as exerted by machinery working upon materials, and operated by men. It is the inclusion of the economic and the human elements especially that differentiates industrial engineering from the older branches of the profession.

REVIEW OF THE ENGINEERING PRESS.

"THE WORLD IS ITS FIELD"

MACHINE TOOLS FOR HIGH-SPEED STEEL.

A DISCUSSION OF THE DESIGN OF MACHINE TOOLS TO TAKE THE HIGHEST POSSIBLE ADVANTAGE OF THE CUTTING POWER OF HIGH-SPEED STEEL.

H. I. Brackenbury—Institution of Mechanical Engineers.

WE have referred before in these columns, in connection with Prof. Rautenstrauch's discussion of lathe-headstock characteristics, to the manner in which the development of high-speed steel has reacted on machine-tool design. This subject is more fully developed in the following review of H. I. Brackenbury's paper "High-speed tools and machines to fit them," read at the recent joint meeting in Birmingham of the Institution of Mechanical Engineers and the American Society of Mechanical Engineers. Much that is valuable in Mr. Brackenbury's paper, his graphical and numerical data of machine-tool performance, we are obliged to omit. The abstract following, however, gives in brief all the essential parts of his discussion.

As a preliminary to the consideration of the design of machines suited to the use of high-speed tools, Mr. Brackenbury briefly reviews the characteristics of the tools themselves. There are three classes of high-speed tool steel: class A, for cutting mild and medium steel; class B, for cutting hard steel (such as tires, etc.); and class C, for cutting very hard steel and for use in cases where a sharp and lasting cutting edge is required, especially useful in cases where deep cuts with fine feeds are used. More power is required to remove a thin, wide chip than a chip of double the thickness and half the width. The additional power required, however, is less the sharper the tool. Tools with blunt cutting angles require more power than tools with sharp cutting angles to remove the same amount of material; but there is the objection to sharp cutting angles that the edge is likely to break.

Within certain limits, the total power used for a given cut, including the power absorbed by friction in the machines, increases at a smaller ratio than the increase in cutting speed. It is a very difficult matter to lay down rules for cutting speeds. Results of tests of high-speed steel under ideal conditions are interesting and useful as indicating the directions in which improvements can be made in both the design and the use of machine tools, but they are not of much use as an indication of what is actually performed in the ordinary workshop. There are so many variables in the actual conditions (Taylor's twelve variable elements do not exhaust the list) that, without a careful study of each particular case, the determination of the best cutting speed is extremely difficult.

"Careful experiments have shown that the sharper the cutting angle, the less power is required to remove a given amount of material, the feed and depth of cut remaining constant. On the other hand, the sharper the cutting angle, the more likely is the cutting edge to crumble or break, and the smaller is the body of steel to conduct away the heat generated by cutting. The importance of working to standard angles is obvious, and the fewer the standards the better, so long as the loss in cutting efficiency is not greater than the gain in grinding and forging tools to a small number of standards." The standards chosen must depend on the variety of work and material and the quality of machines in the shop. Slavish adherence to standards is to be deprecated when many variables are involved; it should be the duty of the manager or foreman to experiment with tools of various cutting angles when a suitable run of work is available. Further, advantage should be taken of improvements in the quality of tool steels. High-speed steel has improved in the past few years and will probably improve in the future, and with these improvements it is found that the cutting edge remains sharp for a longer time and that the cutting angles may be made more acute.

On turret lathes the highest class of high-speed steel is now largely used, and tools with a very sharp cutting angle are employed. Mr. Brackenbury gives data of the performance of high-speed steel in turrent lathes and other machines. Perhaps the most striking instance of its value is in the case of twist drills. Given sufficient power, a high-speed drill does three times the amount of work and requires grinding less frequently than the temper-steel drills. Generally, however, full advantage is not taken of the cutting powers of high-speed steel, although in all cases where it has been introduced valuable economy has been effected by the increased speeds and the increased length of time tools run without the need of grinding.

Not enough attention has been given to the savings accompanying the use of high-speed steel. Where full use is made of modern machinery, the production, in so far as roughing-out goes, is three times what it was under the old conditions. Further, although the power required to drive machines capable of making full use of high-speed steel is very large, the power absorbed for each pound of metal removed is less for high-speed than for low-speed machines. The full saving possible can be made only by setting aside certain machines for roughing and for roughing only. In introducing high-speed steel, it is not necessary to replace all or even many of the old machines, which have quite enough power to carry the finishing cuts at good speed. It is not desirable to use the same class of materials or of labor for roughing as for finishing. When it is not possible to buy new machines, much may be done by making a judicious selection of the heaviest of existing machines and increasing their belt speeds so that high speeds may be run with the back gear in. In some instances the cones have been removed and replaced by wide pulleys, speed changes being provided for by means of sliding gears.

Turning now to Mr. Brackenbury's discussion of machines suited to the use of high-speed steel, it is pointed out that an idea of the saving in cutting time may be gained from a comparison of the powers allowed for machines designed before and after the introduction of high-speed steel. Engineers have grasped the fact that the power which may be usefully employed depends upon the stiffness of the work and not on the height of centres in the case of lathes or the length of stroke, etc., in the case of other machines. The increase in power, of which Mr. Brackenbury gives a number of illustrations, must be accounted for by a desire for increased depths of cut and feeds as well as increased speeds.

There seems to be no finality as to the amount of power which can be applied to a machine. In the desire for rapid production, however, it is important not to overlook the consideration of the cost of power and value of material cut to waste in cases where the work could be made nearer to the size in a more economical way. While it is impossible to lay down any law regarding the limiting point of the weight and power of machines, on account of the number of variables, three principal governing factors may be recognized: (1) the length of time the machine will be used for heavy cutting; (2) the length of time for light cutting; and (3) the length of time at rest. During (1) the machine is used efficiently; during (2) more is being paid for power and capital charges than if a lighter machine were used; during (3) more is paid for charges than in the case of a lighter machine. These considerations evidently point to the importance of using heavy machines for roughing only in every possible case.

The stepped cone is rapidly becoming obsolete, except in the case of small machines. The disadvantages of this method of changing speed are the trouble and danger of throwing a heavy high-speed belt from one cone to another, and the variation in power from the different belt speeds. Speed changes are provided for by sliding gears, in the case of medium-sized machines, and variable-speed motors in the case of larger machines. Motors on the three-wire direct-current system give a large and excellent range of speed. It is well to notice, however, that at certain speeds at light cuts, the efficiency of motor and machine may be far from good. To illustrate what losses of power may take place in a lathe which is apparently perfectly satisfactory, Mr. Brackenbury gives curves showing the electrical horse power at various speeds for a large lathe, the feed and depth of cut remaining constant. The curves show a drop in efficiency at the change from low to high voltage, and an extraordinary gain in efficiency when a change is made from the high voltage and high gear ratio to the low voltage and low gear ratio, the result being that practically the same amount of power has to be paid for at cutting speeds of 18 and 33 feet per minute. Heavy lathes which are required to do both light and heavy turning should have the gear ratio arranged so that the full range of speed may be obtained from either voltage, and builders of such heavy machines should give the total efficiency of lathe and motor at various speeds and loads. It is true that the expenditure of power is in most cases only a small portion of the total expenditure, but when the total expenditure is large, the small portion becomes quite large enough to trouble about.

The gears which are always in mesh should have helical teeth to ensure quiet and smooth running and to prevent chatter. The pinions should be hardened and, of course, all wheels should be made either of forged steel or of steel castings. It is of great importance to cut the teeth of gear wheels to a considerable degree of accuracy. Worm and work wheels should never be used unless hardened. The introduction of high-speed steel has meant the replacing of many work and worm-wheel drives by spur-gear drives. Finally, all feed arrangements must be made amply strong, as in certain cases the side pressure is equal to the vertical pressure on the tool.

A review of recent progress in machine tool design, illustrated with drawings and photographs of typical machines, concludes Mr. Brackenbury's paper. Dealing first with roughing lathes, very heavy machines are now built for taking heavy cuts. The beds are made very wide to give ample support and bearing surface for the saddle, and the spindles are made of what appears to be excessive strength, but it is most important to have ample bearing surface and an absolutely rigid spindle to prevent chatter. A general rule is to make the diameter of the front bearing half the height of the centre. There should always be a hole through the spindle, to accommodate the bolt for drawing up expandings chucks or for supporting the end of a boring bar. The tailstocks should be very massive and clamped to the bed by two bolts in the case of the smaller sizes, and three bolts for larger sizes; the diameter of the barrel should be one-third the height of centres. One maker provides an arrangement of expanding cones with a belt driving by its bevelled edges, and by this means any speed between the highest and the lowest can be obtained. When applied to a cutting-off machines, arrangements are made so that the speed automatically increases as the diameter being cut diminishes.

Turret lathes have been greatly strengthened. One machine has reduced a bar from 2¼ inches to 1 inch diameter at a traverse of 11⅜ inches per minute with an expenditure of 20.7 horse power, when using class C steel. The ordinary steadies were found quite useless at this high duty, and a roller steady has been introduced with excellent results. Such a machine fitted with a roller steady averages an output at least 33 per cent. greater than the output of the older machines designed for the use of ordinary high-speed steel, and at least 100 per cent. more than that of machines built before the advent of high-speed steel, so that the extra cost of the modern machines is small compared with the saving.

Mr. Brackenbury describes in detail two slotting machines adapted to the use of high-speed steel. Concerning jib drilling machines he says that great attention is now being paid to stiffening to prevent deflection of the saddle. One maker provides a double-girder jib with a space between the two girders for the saddle, which is supported by the girders on each side of the spindle, so that there is no twisting movement around the horizontal axis of the jib. Change-speed gear boxes or variable-speed motors are generally provided, allowing from 12 to 15 horse power for the larger sizes. These machines can drill inch holes at a rate of 5 inches per minute, and 100 inch holes per minute through inch plates is ordinary practice. Really fast drilling cannot be done on old machines, as the spring and twist of the jibs cause the drills to break and in many cases the feeding and withdrawing arrangements are very unsatisfactory. Still, high-speed drills can be used to considerable advantage in some of the best of the older machines, although running the drill at high speed and fine feed entails considerable loss of power.

The power allowed for milling machines has been greatly increased within the last few years, but it is very doubtful if milling machines should be used, except in special cases, for heavy roughing work, as the power required to remove material with a milling cutter is very large as compared with tools of the lathe type, about double per pound of material removed.

"A great advance has been made in the cutting speed of planing machines, and naturally with the increase in cutting speed came a desire for a quicker return stroke. Heavy planing machines now have a return-stroke speed of 90 feet per minute and lighter machines are made with a return stroke up to 180 feet per minute, the shock at the reverse being absorbed by recoil springs. Various devices are now made which can be fitted to pre-high-speed planing machines by means of which the above results may be obtained at a moderate expenditure of money, and the results are most satisfactory. It seems a pity that more use has not been made of the arrangement fitted to the planing machines designed by Sir Joseph Whitworth for cutting on both strokes; certainly for roughing out this is very economical."

MODERN METHODS OF MOSQUITO EXTERMINATION.

A DESCRIPTION OF THE WORK IN PROGRESS IN THE SALT MARSHES OF NEW JERSEY.

John B. Smith—Engineering News.

SINCE the discovery that mosquitoes are responsible for the dissemination of yellow fever, malaria and other diseases, mosquito extermination has been added to the problems of sanitary engineering, and in some localities the problem is of no less importance than that of water purification. Even where the disease-carrying species do not exist, mosquitoes sometimes constitute a pest of such magnitude as to warrant the application of engineering methods to the removal of the conditions under which they breed. A campaign of this sort has been begun in the salt marshes of New Jersey and $350,000 has been appropriated for the work by the State. Prof. John B. Smith, under whose direction the work is being carried out, has given in *Engineering News* for September 1 an interesting account of the methods employed.

When Prof. Smith began the systematic study of the New Jersey problem, "it was found that instead of a few, there were many species of mosquitoes:

instead of great uniformity, there was a great diversity in life history; instead of being home-bodies, some forms were great travelers, and that a locality might be almost unbearably afflicted without breeding a single specimen. One fact remained to us, and that is a vitally important one. Mosquitoes develop only in water; it may be salt or fresh, clean or foul, in motion or stagnant; but there must be water in which the larval life can be passed. There need not necessarily be water when the eggs are laid, for many species lay them in mud or in damp places that are only seasonably or occasionally covered, and such eggs may lie dormant for two, three or perhaps more years; but development never takes place until water comes.

"Another vitally important fact brought out by my investigation was, that two species bred abundantly only on salt marshes along our coast, and that both these species were migrants, flying as far inland as 40 miles under favorable conditions. Futhermore, that there might be from six to eight broods annually on these marshes, out of water ranging from pure salt tide to rain fresh. In New Jersey alone there are over 290,000 acres of salt marsh, and over half of that is or until recently has been, mosquito breeding ground. My work demonstrated that over 90 per cent. of the pestiferous specimens in the state were of the salt marsh species, and the importance of dealing with that area became at once manifest.

"Early mosquito campaigns consisted chiefly of getting rid of local stagnant pools and covering large swampy areas with oil—effective enough within its range, but out of the question in work covering a state. When the entomologist had worked out all the factors dealing with the life cycle and habits of the species, it became a problem for the engineer.

"Theoretically, the matter is simple enough. An ordinary salt marsh is almost level; is porous, so that water runs out easily; and outlets to tide-water are usually within convenient reach. Experiment and observation proved that large ditches were not needed; but that, to be effective, ditches must be deep, straight and with even sides and bottom. The final outcome was a trench 10 inches wide and 30 inches deep, wherever the character of the ground would stand it. At first shovels and spades were used in the digging work; but the results were not good and the cost was great. Then a modified hay knife or bog saw was used to cut the sides of the ditches, and the intervening sods were taken out with hooks and spades. This was much better and cheaper; but not sufficiently rapid. Two of the contractors invented spades, especially adapted to this type of ditching, by means of which a sod 10 inches wide, 30 inches deep and 6 to 8 inches long, was taken out at each plunge. With such spades a gang of two or three men could run out from 600 to 800 feet of perfect ditching in an eight-hour day.

"Finally, from a model patented many years ago, a power ditcher was produced, with which a crew of five men can dig 4,000 feet of ditch in an eight-hour day, and the cost was reduced to about 2 cents per running foot. This machine runs on planks over the marsh, and the cutting knife is at the back, so that the body is always ahead of the ditch. The essential point is a plunging knife forming three sides of an oblong, the fourth or open side behind. This knife has the sides 12 inches long, the front 10 inches wide, is firmly attached to a sliding frame which, in turn, is suspended from the end of a long, powerful lever beam. This beam is slotted and in this slot runs a pin attached to one of the spokes of a heavy driving wheel. As this wheel revolves, actuated by a 12-horse power gasoline engine, the lever beam is alternately depressed and lifted, forcing the knife deep into the marsh and lifting it out again. At the low point of the depression a swinging knife comes into play, cuts under the sod at the depth of 30 inches and remains to serve as a bottom to the knife until it is lifted clear of the ditch. The sod is hooked off by an attendant who draws it to one side and is kept fully employed when the machine is smoothly at work. With each plunge of the knife the machine moves forward 1 foot, so that sods of even size, 10 by 12 by 30 inches, are taken out and laid in an even row alongside the ditch.

"Up to the present time some 25,192 acres of salt marsh have been drained in New Jersey, by 3,464,974 feet of ditches, and the work has demonstrated its effectiveness. This drainage is only sufficient to remove surface water fast enough to prevent mosquito breeding; but it results, incidentally, in a great improvement in the character of the marsh and the amount of hay produced on it.

"The work now being carried on in New Jersey is along a carefully prepared plan; but at present, so far as the state is concerned, covers only the salt-marsh or migrating forms. The local breeders are considered as coming under the jurisdiction of the municipality where they are found and only suggestions and advice are given. The entire marsh area of the state has been carefully looked over, the indicated drainage scheme has been roughly laid down on tracings from the State Geological Survey Maps. The cost of carrying out the scheme was put at $350,000.

"Not all marsh areas are as easily dealt with. Some of them are in pockets among the sand hills, and the turf is too shallow to hold a ditch. In such cases filling must be resorted to where the areas are not too large. This filling has also developed as the result of experience, and solid work is no longer attempted. The low area is first covered with layers of shrubs, seaweed, hay or whatever is most readily available, and then enough sand is shoveled over it all to keep the loose filling in place. The loose projecting twigs and branches serve excellently to hold blowing sand during high winds and storms, and in a year or two a solid fill naturally results.

"In larger confined areas where there is no outlet, yet another method—that of draining to a center—is adopted. Areas of that sort are usually very low, and at the lowest point of all, water stands for days and weeks, especially early in the season. Out of such areas come the early spring broods and usually the latest of the season as well. It is easy enough to locate the low point during the summer, and there we dig a pool from 6 to 10 or 15 feet square, and about 3 feet deep. In the center of this pool a large barrel or hogshead is sunk. As the barrel is always below the tide line, its contents never dry out. Ditches, as needed, are drawn to this pool, using the natual drainage lines so far as possible, and then the place is stocked with 'killies,' the little species of *Fundulus* which run in every creek throughout the marshes. It is surprising how quickly such areas dry out by this method, even after long-continued rains. When the area is flooded, the fish run everywhere and quickly dispose of any wrigglers that appear. As the water goes down the fish and wrigglers retreat with it, and the more concentrated the larvae, the easier do they become prey to the fish. In a droughty period the fish retreat to the central pool and finally to the barrel, which never dries out because it is below tideline. Indeed, in most of the barrels thus far sunk, there is a distinct tidal change of level varying from 6 to 12 inches, and it may be that considerable water actually gets away through the sand from these pools.

"Another type of permanent improvement which eliminates mosquito-breeding marshes, is sand filling by dredges. Hundreds of acres have been treated in that way by improvement companies and promoters, and miles of territory have been made available for settlement.

"Inland conditions vary more greatly and require a greater variety of treatment. About cities and towns, the dirty and stagnant water problem is best referred to local boards of health, who should deal with it as other nuisances are dealt with. The matter is not entirely simple, since it also involves the city catch-basins as breeding places; and here the city engineer can aid materially in the selection of a type of basin that offers least chance for breeding.

"In woodland areas there are always depressions that are water-filled in early spring, and develops one brood of mosquitoes that hang about until mid-summer. Where such areas are to be dealt with, drainage and filling must be done, and here again a great deal of filling can be very cheaply done, because no solid fill is necessary. Grass, leaves, branches, anything that forms a bed that prevents free water from standing above, will answer the purpose.

"Deep cold swamps are not dangerous as breeders and need no treatment; neither do open-water areas exposed to wind currents. But overgrown shallow edges of open swamp areas or ponds are dangerous and must be dealt with. Sometimes merely killing out the vegetation along the edges will answer, as thereby fish will be given a chance to get at any insects that may appear. At others it may be necessary to deepen an infested area or fill it. No two problems are entirely alike here, and each must be dealt with according to its special needs."

THE FIELD ASSAY OF WATER.

THE USES AND LIMITATIONS OF FIELD METHODS OF WATER TESTING AS COMPARED WITH LABORATORY METHODS.

R. B. Dole—Engineering News.

DURING the last six field seasons more than 3,000 field assays of natural waters, by the methods suggested by Marshall O. Leighton in 1905, have been made by United States Geological Survey parties. The purpose of Leighton's methods have been widely misunderstood. They are not intended to displace laboratory analyses, nor is it claimed for them that they yield results comparable in accuracy or availability with laboratory methods. Leighton's purpose was to place at the disposal of engineers, chemists, geologists, and scientific explorers in general a means of making in the field partial approximate assays of natural waters by the use of solid reagents and apparatus that can be carried in a knapsack. The experience of the Geological Survey has been that in careful and trained hands Leighton's tests, granted a proper appreciation of their limitations, on the part of the user, are of great practical utility in industrial and geological reconnaissance.

The limitations of the field assay are defined by R. B. Dole of the Survey in *Engineering News* for August 11. Fifty-two waters, ranging in total solids from 25 to 5,200 parts per million and representing the common kinds of surface and underground waters in the United States, have been analyzed in the laboratory and tested by field methods. The results of the two methods Mr. Dole presents in parallel columns. Without reproducing the exact numerical data we may summarize briefly Mr. Dole's discussion of the results and his conclusions as to the practical utility of the field assay.

Dealing first with the determination of bicarbonates, "the estimates of bicarbonates in the laboratory were made by titrating measured amounts of water with N/50 sulphuric acid in the presence of methyl orange indicator. The field tests were done in reverse manner; a proper number of tablets of sodium acid sulphate were dissolved in a small amount of the water to be assayed, methyl orange was added and then water until an alkaline endpoint was reached, after which the volume of liquid was measured. One of the tablets used in the tests is equivalent to 2.49 milligrams HCO_3. The parts per million of bicarbonates (HCO_3) in a water can readily be computed from the amount of water, the number of tablets, and the value of one tablet in milligrams of HCO_3."

The average error of the field tests in the 44 cases which Mr. Dole considers significant was 6.2 parts per million, or 3.5 per cent., with waters containing 100 to 350 parts per million of bicarbonates; the errors ranged from 0 to 9 per cent. and were equally divided between positive and negative. It is clearly established that the error is not a constant one, due to error in the value of the tablets or to the change in shade of the indicator, but that it is variable and is caused probably by error in measuring the water. The average error of 3.5 per cent. corresponds to 2.1 cubic centimetres, not an unreasonable variation considering the facilities for measurement. "Most waters do not contain normal carbonates (CO_3) and a qualitative test suffices to show their absence; but if it is necessary to make the quantitative determination it may be performed on a separate portion of water in the presence of phenolphthalein and the bicarbonate figure may be corrected in accordance with the result."

Chorides were determined in the laboratory, when less than 100 parts per million, by titrating 100 to 250 cubic centimetres of the water concentrated to 25 cubic centimetres with a solution of silver nitrate, 1 cubic centimetre of which was equivalent to 0.5 milligram of chlorine; and when more than 100 parts per million, by precipitating and weighing the chlorides as silver chloride. In the field tests, 50 cubic centimetres of water were titrated with tablets and quarter tablets of silver nitrate. "For low chlorides tablets equivalent to about 1 milligram of chlorine were employed, and as one-quarter tablet in 50 cubic centimetres of water is equivalent to 5 parts per million of chlorine, the field results may vary from the true values 5 parts, a difference which may be equivalent to an error of 100 per cent. Such discrepancies offer little practical disadvantage, however, for it is as useful in geological or industrial reconnaissance to know that a water contains less than 9 parts of chlorine as to know that it contains, for instance, exactly 5.4 parts." The accuracy of low-chlorides estimates is increased by using 100 instead of 50 cubic centimetres of water wherever practicable, but no particular advantage has been gained in using weaker tablets instead of quartering the tablets of ordinary strength.

The average error of 22 tests of waters containing more than 50 parts of chlorides was 6 parts, or 3.2 per cent., and the errors are almost equally divided between positive and negative. "If the chromate indicator is added at the beginning of the titration of waters exceeding 400 or 500 parts of chlorides, an excess of silver nitrate choride formed during solution of the tablets becomes stained with silver chromate that is decomposed with difficulty. It is better, therefore, to make first a rough estimate of the chlorides and then to repeat the determination, the indicator in the latter test being added near the end of the titration. All the tablets except one or two may be ground with a small quantity of water, then the remainder of the measured portion of the water may be put in, and the titration completed in the usual manner. This modification involves little extra work and increases the accuracy of the results."

Sulphates were determined in the laboratory by the usual gravimetric method in 250 or 500 cubic centimetres of water. In the field tests about 1 gram of coarsely pulverized barium chloride was added to about 100 cubic centimetres of water made very slightly acid to methyl orange by the addition of hydrochloric acid (1—1). The mixture was then shaken for ten minutes or until the precipitant was entirely dissolved and the turbidity of the liquid was then measured by means of the regular form of candle turbidimeter in a shaded corner of the laboratory in daylight. The solution was kept constantly and thoroughly agitated while three readings were made; a standardization table gives the amount of sulphates corresponding to the average of the three readings. The success of the field method depends upon the addition of a minimum of acid and the constant agitation of the liquid in order to prevent concentration of barium chloride at the bottom of the tube during precipitation and to prevent agglomeration after precipitation. The use of the regular turbidimeter is limited to the estimation of sulphates from 30 to 600 parts per million. Less than 30 parts of sulphates were determined by comparison of the turbidity with that produced in waters containing known amounts of sodium sulphate treated with acid and barium chloride. These standards of course cannot be carried in the field, but it is possible for a skilled observer, to estimate from memory below 30 parts certainly within 50 per cent. Above 600 parts the water was diluted to a convenient strength with water free from sulphates before precipitation. The best results are obtained in readings on waters containing between 56 and 265 parts of SO_4, and it is best to dilute to bring the readings between these limits.

The average error of the tests of the 27 waters containing more than 30 parts per million was 10 per cent. For turbidimeter readings between 2 and 19 centimetres the average error is 8.5 per cent. For readings less than 2 centimetres and for sulphates greater than 600 parts, the errors of single estimates are much greater, averaging 15.4 per cent. in the nine cases reported by Mr. Dole. Indeed, individual determinations of high sulphates are liable to great error.

In the laboratory tests for iron, "the iron in the residue from 500 cubic centimetres of water was removed as ferric hydrate and redissolved; then the amount of iron in this solution, or in an aliquot part of it, was estimated by the usual colorimetric method, the reddish hue developed by potassium sulphocyanide being compared directly or indirectly with that developed in standard solutions of ferric chloride. In the field tests, 45 cubic centimetres of water and 2 cubic centimetres of concentrated nitric acid are thoroughly mixed and allowed to stand 5 minutes; 3 cubic centimetres of a 2 per cent. solution of potassium sulphocyanide are then added." The red color of the solution was then compared with that of standard celluloid discs. This is the regular field method recommended by Leighton, with the exception that the coloring comparison was made immediately after the addition of the potassium sulphocyanide instead of 10 minutes later, as it was found that the compounds producing the red color are progressively decomposed by free nitric acid. In a second series of tests the mixture of water and nitric acid was allowed to stand one hour before addition of potassium sulphocyanide. It is apparent from the results that in most cases the iron is more completely oxidized if the second method is followed. The errors in the tests by the first method vary from 0.2 to 2.4 parts per million (8 to 100 per cent.) and in those by the second method from 0.1 to 1.0 (5 to 100 per cent.). The degree of change into the ferric form depends on the composition of the water and the chemical condition of the iron. Apparently much organic matter retards the change more than anything else in natural waters.

The estimation of the total content of scale-forming ingredients in the field is made difficult by the lack of satisfactory field methods for the determination of calcium and magnesium. The turbidimetric method proposed by Leighton for calcium is subject to great and uncertain errors, and the procedure devised by Catlett for magnesium has not yet been applied to water assaying. "The figure for total hardness obtaining by titrating a measured portion of water with sodium oleate tablets can be considered an approximate value for scale-forming ingredients up to 100 parts per million. Figures for total hardness greater than 100 parts are usually too low because of the interference of calcium and magnesium soaps with the reactions. For very hard waters an estimate of the probable scale can be made from the figures for total hardness, sulphates and bicarbonates. If the sulphates are computed to calcium sulphate and the bicarbonates to calcium carbonate and the two amounts added together, the sum represents the greatest amounts of calcium and magnesium compounds that could be made in the scale. An average between this sum and the total hardness by the sodium oleate method represents more or less approximately the amount of scale-forming material in normal hard waters. The relation may be expressed thus:

$$S = 0.41\ HCO_3 + 0.71\ SO_4 + 0.50\ H$$

in which S, HCO_3, SO_4, and H represent respectively the amounts in parts per million of scale, bicarbonates, sulphates, and total hardness. If this approximate figure is considered in connection with the amount of chlorides and the possible presence of hydrogen sulphide, as revealed by the odor, or of free sulphuric or hydrochloric acids, comparative classification in respect to steaming qualities may be made accurately enough for reconnaissance work. This method of computation was successfully used in classifying 300 assays of waters made in Iowa and Indiana during a study of boiler-water conditions in those states.

"It may be concluded," Mr. Dole says, "that the assay tests for chlorides, sulphates, carbonates, and bicarbonates are as accurate as they need to be for preliminary work. The iron test is likely to give low results in many waters, and more time should be allowed for the oxidation of the iron. The test for total hardness, though laborious in hard waters, yields information valuable enough to make its performance worth while. The calcium test cannot be relied upon more than to indicate whether waters are high or low in calcium, and the results of this test should not be expressed in figures. In reporting results no decimals should be given except in iron, where one decimal place may be reported. The assays should always be made by persons having some knowledge of chemistry and a thorough training in the technique of the tests as well as an appreciation of their limitations."

THE IRON ORE RESOURCES OF THE WORLD.

AN ESTIMATE OF THE ACTUAL AND POTENTIAL RESERVES IN ALL COUNTRIES WHERE IRON ORE IS WORKED ON A CONSIDERABLE SCALE.

International Geological Congress.

IN 1908 the International Geological Congress initiated an international inquiry into the amount and distribution of the world's supplies of iron ore. The work is now completed and the results of the investigation, which probably represent the most accurate estimate of iron ore reserves yet made, have been published in a three-volume report which was presented to the Congress at the Stockholm meeting just closed. A brief summary of the report is taken from a review in *The Engineer* for August 26.

"The statistics have been classified into different groups; thus (*a*) includes such cases in which a reliable calculation of the extent of the deposit has been carried out; (*b*) includes those deposits in which only a very approximate estimate has been arrived at, and (*c*) includes such deposits as could not be represented in figures. Of the whole of the territory investigated 13.3 per cent. falls under group (*a*), 10.3 per cent. under group (*b*), and 51.6 per cent. under group (*c*), the remaining 24.8 per cent. not being accessible for inquiry. The area embraced by group (*a*), which consists of the greater part of Europe, with the exception of some of the Balkan States, as well as the United States of America and Japan, comprises 17,368,117 square kilometers; in this area 7,020 million tons of actual resources and 49,295 million tons of potential resources are known, the iron quotient (which is arrived at by dividing the quantities by the area) amounting to 404 million tons for the actual iron resources and 2,838 million tons for the potential resources. The total amount of known iron ore resources of the world is made clear by the following table, the quantities being millions of tons:

Ore Resources of the World.

	Actual Reserves.		Potential Reserves.	
	Ore.	Iron.	Ore.	Iron.
Europe	12,032	4,733	41,029	12,085
America	9,855	5,154	81,822	40,731
Asia	260	156	457	283
Australia	136	74	69	37
Africa	125	75	many thousands	
Totals	22,408	10,192	123,377	53,136

"As the production of pig iron at present can be stated in round figures to amount to 60 million tons yearly, the supply hitherto known of actual ore resources would not be sufficient for two hundred years, on the supposition that the production of pig iron remained stationary. To what extent the future of iron will become dependent upon low-grade ores becomes apparent from the following figures, showing the comparatively small remaining supplies of ores which contain more than 60 per cent. of iron:— The actual supplies of these rich iron resources are 1,300 million tons, and the potential 687 million tons, and the amounts of iron in these ores are 850 million tons actual and about 408 million tons potential. Four-fifths of the known and recorded rich ores come from the deposits of northern Sweden.

"In Europe the greatest actual ore reserves are the minette ores distributed between Germany, France, Luxemburg and Belgium, amounting together to about 1,850 million tons of metallic iron, Next in order come the ore reserves in the north of Sweden with about 673 million tons. Amongst the potential resources, the clay-ironstones of Great Britain, chiefly divided into two centres, viz., one in England and Wales, with 7,100 milion tons, and the other in Scotland, with 2,400 million tons, are first. In North America the most important ore resources lie in the Lake Superior region, with about 2,000 million tons actual and 36,000 million tons potential expressed in metallic iron. Next to these are the considerable deposits in Newfoundland, with about 1,960 million tons of actual reserves. In Cuba there are about 857 million tons actual and 454 million tons potential reserves. In South America only one single important iron ore centre is known, and this is situated in the province called Minas Geraes; it contains at least 3,055 million tons of potential iron reserves. There are no definitely fixed iron ore centres in Africa, while in Asia and Australia no important centres are known.

"The report on the iron ore reserves of the United Kingdom was drawn up by Prof. Henry Louis, who estimates the resources of the United Kingdom as follows:

	Tons.
Stratified iron ores of the carboniferous formation	34,000,000,000
Stratified iron ores of the secondary formation	5,000,000,000
All other iron ores	500,000,000
Total iron ore	39,500,000,000

As the average iron contents of these ores range from 30 to 35 per cent., the above total corresponds to about 13,000 million tons of iron. At the present time the United Kingdom produces about 15 million tons of iron ore annually which is about 5 million tons of metallic iron. It is thus obvious that the iron resources of the country are fully equal to the demands that the future can possibly make upon them, if regard is merely had to quantity. But it must be pointed out that in these figures no attention has been paid to the question whether these ores can or cannot be worked with profit, and it may be said that the largest proportion of the above quantities cannot be profitably worked at the present time. It is, however, considered by no means impossible that some change may render of commercial importance many ores which are useless to-day, seeing that the data given in the report are concerned with true iron ores, namely, such as contain at least 25 per cent. of metallic iron.

"A classification of the ore reserves of the German Empire has been made by Mr. G. Einecke and Mr. W. Köhler. Taken altogether, the ore resources of the German Empire are as follows:—Actual, 2,840 million tons; potential, 1,067 million tons. To this is to be added a very great amount which the authors have not yet found it possible to express numerically. According to Mr. P. Nicoll, who has written the report on the iron ore reserves of France, the three classes of ore which predominate in the country are the minette ores in Lorraine, the Silurian ores in Normandy, and the ores occurring in the form of veins in the Eastern Pyrenees—amounting altogether to 95 per cent. of the resources of the country. Taken altogether, the available ore reserves in France may, in round figures, be estimated at 3,300 million tons at least. As regardes Belgium, Mr. Georges Lespineux finds that the total of the reserves of ore is 62½ million tons.

"Spain may be considered as a country possessing considerable iron ore reserves, which Mr. Louis M. Vidal estimates at 711 million tons. Portugal, on the other hand, is poor in iron ore deposits, and the estimated amounts do not exceed 17 million tons of ore in sight, and 58 million tons which may be classed as probable. In European Russia, the principal deposits of iron ore are the Central and Southern Russia, the Urals, Poland, and the Caucasus, the total reserves of which are estimated by Mr. K.

Bogdanowitsch to amount to 1,921 million tons. Some of the iron ore reserves of Sweden are to be accounted among the greatest in the world, and are now almost exclusively being mined for export. The actual reserves of the country are estimated at 1,178 million tons, and the potential at 224 million tons. The reserves of Norway may be put in round figures at 350 million tons, containing 30 to 36 per cent. of iron.

"Prof. J. F. Kemp, of Columbia University, estimates the actual ore reserves of the United States of America to be 4,257 million tons and the potential reserves are calculated as 75,105 million tons. The potential reserves of Brazil have been calculated to amount to 5,710 million tons, but this estimate might be multiplied several times over when the country has been fully examined. The iron ore reserves of Asia are, on the whole, little known. The actual total is 260 million tons, 100 million tons of which are credited to China and 55 million tons to Japan. No estimates are made of the iron ore deposits of the Transvaal or Cape Colony."

STEEL BELT CONVEYORS.

A BRIEF DESCRIPTION OF STEEL BELT CONVEYORS RECENTLY PUT IN OPERATION IN SWEDEN.

Alfred Gradenwitz—Engineering and Mining Journal.

WE have already described in these columns* the recent application of steel belts to power transmission in Germany. It is now reported by Alfred Gradenwitz in the *Engineering and Mining Journal,* for September 3, that after several years of experimentation steel belt conveyors have been placed on the market by a Swedish steel firm, and are giving very satisfactory and economical service in a number of installations in northern Sweden.

So far, the steel belt conveyors have been manufactured in lengths up to 100 metres, in widths of 8 to 16 inches, and in thickness from 0.03 to 0.04 inch. The lengths are readily riveted together to form any required length, and wherever any special width is required, two or more parallel belts can be arranged side by side. The material used is a high-grade charcoal steel. The belts offer high resistance to tensile stress and abrasion and are at the same time extremely flexible. They are adapted to the carriage of all kinds of material, and are cheaper to construct and install than high-grade belts of other materials. One important reason for their cheapness is the comparatively few idler pulleys required. The maintenance cost is small and repairs are easily made by simply riveting in a section of any desired length. A low power consumption is the result of the low coefficient of friction, the smooth surface of the steel and the storage of the energy expended in bending the belt around the pulleys instead of its conversion into heat.

Troughing of the belt itself is, of course, impracticable, and the steel conveyors are installed in a trough of wood lined with sheet metal or wholly of metal, the sides of which may be inclined 15 degrees without danger of obstruction. Any contact between the belt and nail heads must be avoided. To prevent the belt from lifting off the trough, due to the accumulation of material underneath, the longitudinal elevation of the conveyor must be straight or slightly convex. By proper construction of the joints, any material accumulating beneath the belt may be made to travel in the direction of transport and discharged through a hole in the trough in front of the belt pulley.

An ordinary wooden drum, built up of planks, the periphery covered with a layer of rubber belting, 3 to 4 millimetres thick, gives satisfactory service as a belt pulley. The axles are centred in cast or forged plates, fixed to the side walls of the pulleys. Cast-iron pulleys are usually unnecessarily expensive. When they are used they should be covered with wood and rubber, the rubber being for the purpose of compensating for the buckling and scratching effect of material between the belt and the pulley. The pulley bearings should be made capable of adjustment through 100 to 150 millimetres in the direction of travel, the two sides being adjusted independently. Idlers are used for supporting the returning side of the belt, and in large installations a few idlers are used advantageously to preserve alignment. The distance between supporting idlers is about 10 metres, with the last placed about 3 metres from the belt pulley. They are made of cast iron or wood, preferably the latter, and are from 40 to 50 centimetres in diameter. The bearings of all idlers should be capable of adjustment.

---

* The ENGINEERING MAGAZINE, December, 1909.

The belt sections are joined by ordinary lap joints with two rows of rivets 4 millimetres in diameter and 30 to 35 millimetres apart. The triangular lap is most satisfactory. In making the final joint the ordinary type of belt stretcher is used. The joints are lapped about 60 millimetres, the inside surfaces of the belt ends being coated with some rust-preventing material.

In installing steel belt conveyors it is best to provide for charging the material as far as possible from the rear belt pulley, in order that the pulley may be readily accessible. One of the advantages of the steel belt is the ease with which even the finest materials may be discharged at any point by means of a scraper. The capacity of the conveyor is proportional to the speed and approximately to the square of the width. Under ordinary conditions 50 metres per minute is a suitable speed, though in some cases a speed of 100 metres per minute should be reached. The proper belt width depends upon the kind and quantity of material to be transported. For planks, timber, etc., the belt width should be 1.5 times the width of the individual pieces; for ore, charcoal, firewood, blocks, etc., the belt width should be at least equal to the maximum length of the pieces; and for sawdust, shavings, and other waste materials, the belt should be wide enough to carry the materials without their coming in contact, to any considerable extent, with the side walls of the trough.

While, in general, the power consumption is low, for the reasons given above, it depends upon the kind of material transported, the weather conditions and other factors. One belt 120 metres between pulleys and 400 millimetres wide, installed to convey 50 cubic metres of charcoal per hour at a speed of 50 metres per minute, requires, including the gear and motor, about 3.6 electrical horse power at no load and 5.1 horse power at full load; in this case the gearing and motor alone absorb 2.1 horse power. In another plant two parallel belts, 300 millimetres wide and 150 metres long, transporting 100 cubic metres of charcoal per hour at a speed of 50 metres per minute, require at no load 6.3 horse power and at full load 9 horse power. In a third installation, for transporting chopped firewood, a belt 410 millimetres wide and 80 metres long requires, when full and travelling at a speed of 50 metres per minute, about 4 electrical horse power.

REFUGE CHAMBERS IN COAL MINES.

A DISCUSSION OF THEIR LOCATION, DESIGN, EQUIPMENT, AND COST.

George S. Rice—West Virginia Coal Mining Institute.

GENERAL interest in the systematic establishment in coal mines of refuge chambers equipped with means of communication with the surface and stored with food, water, and medicines, has been awakened by the history of recent mine explosions in the United States. The notable recovery of 20 living men from an improvised refuge chamber in the Cherry mine, a week after entombment, is a case of especial interest. There is no doubt that in the majority of recent disasters men in certain portions of the mines have not been killed outright, but have lived for hours and even days after the explosions, finally losing their lives in fruitless wanderings in search of means of escape. If these men had had at their disposal refuge chambers with telephone connection with the surface, with a supply of food, water and good air, they could have awaited rescue with perfect safety.

George S. Rice, of the Technologic Branch of the United States Geological Survey, has discussed the design, equipment and cost of refuge chambers in a recent paper before the West Virginia Coal Mining Institute, printed in the *Engineering and Mining Journal* for August 27. "The majority of mine disasters," he says, "are due to explosions, and most of them in this country have their origin at the working faces. Usually the main explosive wave rushes along the haulage road that provides its fuel—coal dust—until it reaches the exits into the open air. There are frequently branch explosive waves that traverse some of the cross headings or entries. More particularly is this true when the rooms are connected through from heading to heading and provide an abundant supply of fresh, dry coal dust. In exceptional cases, notably at Marianna, Penn., and recently at Mulga and Palos, Ala., the flame of the explosion has penetrated throughout the mine. In these mines there was a small amount of methane given off in the working faces, which undoubtedly tended to widen the explosion in each case. In a typical coal-dust explosion where there are some wet stretches of passageways, wet from either natural or artificial causes, there are likely to be some roads and districts unpenetrated by flame. This suggests the value of a refuge chamber in each district and a complete separation of one district from another by continuous pillar, where the room-and-pillar system is used. The entrance and exit for haulage and ventilation of each district should be located at one point and the entrance and exits protected by special zones which are kept free from dust, or the dust thoroughly wetted or covered by rock dust.

"Such information as we have at present leads to the belief that these zones can be made impenetrable to an external dust explosion when uncomplicated by the previous presence of methane in the air passing through the zones. The latter would be an exceptional condition. An explosion within a given district would probably traverse its respective protection zone and possibly reach the nearest exit to the open air, but the explosive wave should not enter the other districts if the inert zones are properly arranged and protected.

"Suppose, then, there be a refuge chamber in each isolated district, the miners acquainted as they should be with the location of the chamber, rush to it on hearing the explosion or being notified of it if in a distant district. In an inclosed district, the afterdamp would come in only slowly at the entrance until the explosion doors at the fan had been replaced, so that in most cases in a carefully planned district the men would have ample opportunity of reaching the refuge chamber before the blackdamp drifted or was blown in. Such a chamber should be connected by a protected telephone line with the surface, preferably coming down a drill hole direct into the chamber. This drill hole could also be used for suppying fresh air under pressure. Under such circumstances, the imprisoned men, encouraged by communication with the outside and supplied with stored food and water, could live for weeks, if necessary, until safely reached by rescuers."

While the maximum size of a refuge-chamber district will depend somewhat on the geological and physical characteristics of the seam and the method of working, it is desirable to have it bear some relation to the maximum number of men employed in a district ventilated by a separate split of air. A common maximum is 100 men per split, but as new districts or panels are forming while others are being worked out, the average number employed in a district may be taken as 50. A medium-sized mine employs about 200 men on the day shift, and a large mine about 500. In medium-sized and large mines, therefore, there will be from 4 to 10 live districts for which refuge chambers will be required.

If these chambers are provided for in

laying out the mine, the cost per ton will be insignificant. The drill holes put down in prospecting or for the drainage of gassy seams, if cased and protected from injury at the surface, serve as the most valuable feature of the refuge chamber. While the refuge-chamber drill holes are better large, the ordinary prospect hole which may be cased with a 2-inch pipe will accomplish all that is strictly necessary. A larger internal diameter may be obtained if the holes are bored on the Brejoha system and lined with cement.

Oxygen rescue apparatus supply 2 litres of oxygen per minute, more than sufficient for a man at rest. About 10 litres of free air per minute will be required per man, or, assuming a maximum of 100 men in the chamber, 1,000 litres per minute of air at atmospheric pressure, equivalent to 60 cubic feet of air per minute compressed to 80 pounds per square inch, a quantity which could easily be delivered by even a 1-inch pipe to depths of over 1,000 feet. The exhaled and surplus air will be discharged into the mine. The installation of a hand-driven suction fan at the bottom of the hole, making the refugees independent of external machinery to get air, has been suggested; such a fan should be offset from the foot of the hole by means of a tee, and valves should be inserted to permit the use of the hole for other purposes.

To allow a man to stretch out on the ground, about 12 square feet of space is required. The chamber would require, therefore, an area of 1,200 square feet to accommodate the maximum number of 100 men. It may be an ordinary working room and driven as such, though for the sake of speed in preparation it may be advisable to limit its length to 100 feet. "The chief features to be observed are (1) to make the room neck or necks of great length; (2) to make the pillars on either side of good thickness, and make the crosscuts to adjoining rooms or entries in the process of driving the room as narrow as possible, so as to lessen the difficulty and expense of building tight masonry or concrete stoppings in same on completion of the chamber. Where the State laws do not require crosscuts nearer than 80 to 100 feet, the refuge chamber could be driven up without crosscuts, using instead a line brattice to carry ventilation to the face.

"The entrance to the chamber, after the crosscuts have been securely and strongly sealed, should be at the heading or entry only. There should be two entrances at the heading where practicable. The reason for two is to provide for ventilation under ordinary conditions, and in case there should be a fall of roof on the entry, blocking one of them, the other entrance would be available. The entrance used in driving the chamber would have to be wide enough to admit a mine car, though this width should subsequently be reduced by heavy masonry securely keyed into the ribs to keep down the width of the doors to about 30 inches. The other entrance could be driven narrow by pick. Normal ventilation would be established by placing a curtain across the entry or heading, and if necessary, carrying a line brattice up the room.

"Opposite one of these entrances there should be a crosscut, with doors through the pillar to the parallel heading or entry to allow the men to enter from that side. The entrances into the chamber should each be guarded by at least three strongly built doors with frames recessed into the rib or masonry. It does not seem essential that these be made of iron. It is rare that fires resulting from explosions are started in the interior of the mine, without immediate extinguishment by the afterdamp. When fires result from an explosion it is usually near the entrance, where the fresh air has come in before the coked dust has cooled off. There is no objection whatever to iron doors, but it is better to keep down the expense of installation and have frequent refuge chambers instead of one or two very expensive ones. The doors should open inward to the chamber and normally be kept open by a button, though self-closing. This applies to district chambers in the interior of the mine and not to a special fireproofed chamber, such as has been proposed for instalment at an escape shaft, and in which it may be better to keep the doors closed. The first men entering the district would shut the doors. The doors should be carefully hung and fit tight, but no extra or unusual tightness would be required if there was a cased drill hole from the surface, down which air could be forced under pressure. It might, in fact, be found necessary to provide the pipe recessed along the rib behind the door casings with an automatic relief valve in same to prevent excessive air pressure on the men, should the doors seal very tightly."

In shaft mines, one chamber near the shaft would be advisable, fireproofed and equipped with iron doors, to provide a refuge for men who might be able to reach the bottom after any explosion before the hoisting arrangements, if injured, had been repaired, and also for use as a hospital and a base for rescue parties. Shaft arrangements vary so widely that it is not possible to specify the size and shape, but the general equipment would be the same as for the district chambers.

In all cases signs and directions should be placed along the headings leading to the chambers, and each new employee should have carefully explained to him the location of the chambers and the use of the equipment. The chambers should be whitewashed and the floors kept swept.

As to the equipment needed, Mr. Rice mentions specifically the telephone, which should be of the iron-encased type; a privy, located in a rib hole or one of the sealed crosscuts and provided with sand and disinfectants; drinking water, kept in covered casks and renewed from time to time; food in cans and tins, a dozen or more dry-cell electric lights, and two or three safety lamps with match relighters, all stored in wall cases with glass fronts; one oxygen resuscitation box with an extra oxygen cylinder, two or more oxygen rescue apparatus, and two or more portable chemical fire extinguishers; a roll of canvas or brattice cloth; and disinfectants, simple medicines, and a box containing first-aid remedies and implements. This list, of course, can be added to indefinitely, but it is much more important to have the apparatus and supplies so maintained as to be instantly available than to have an elaborate equipment.

The following estimate of the cost provides for a good equipment. Apparatus mentioned above and not included in the estimate should be considered as part of the mine equipment. The room is not considered an added expense, except for the extra length of neck. The cost of drilling the hole is considered part of the cost of prospecting; the cost of casing for an assumed depth of 500 feet is alone considered. The telephone is not regarded as an extra cost.

ESTIMATED COST OF REFUGE CHAMBER.

500 feet 2-inch pipe casing, in place	$50
50 feet excess room neck yardage and special entrance	50
5 room crosscuts, say 100 feet of yardage	50
5 masonry stoppings at $10	50
6 masonry door frames at $5	30
6 doors and frames at $6	36
Sanitary closet and fixtures	15
Wall cases with glass fronts	20
Casks, pails and miscellaneous fittings	10
Food in tins and cans	25
6 dry-cell electric lights at $5	30
2 safety lamps at $5	10
Oxygen resuscitation box with two cylinders	45
First-aid box, medicines and disinfectants	25
Miscellaneous, say	54
Total	$500

The surface arrangements for air supply will vary according to the topography and ownership of the surface, and the regular mine equipment. If the mine has an air compressing plant, it is most satisfactory to connect the top of each refuge-chamber drill hole with the central compressor plant. If there is no compressor plant but an electric plant, a small motor-driven compressor can be used for each hole, or in case the hole is large enough and not too deep, a high-speed blower. The telephone line, which will be used for the regular business of the mine, should run to the central plant or office. The cost of the surface equipment when compressed air is available would be merely the cost of the outside pipe lines, which need not be large, probably $1,500 to $2,000 for a mine with six chambers. When electric power only is available, the cost of transmission line and motor-driven fan or compressor will probably not exceed $500 for each drill hole. The cost of refuge chambers for an average mine will not exceed $10,000.

PEAT INVESTIGATIONS IN CANADA.

A REVIEW OF THE WORK UNDERTAKEN BY THE DEPARTMENT OF MINES TO DEVELOP THE PEAT INDUSTRY.

Eugene Haanel—American Peat Society.

CANADA has attacked the problem of peat utilization in a highly practical manner. Some three years ago a Commission was sent abroad to investigate the technical and economic aspects of the peat-fuel industry in Europe. A systematic campaign for the development of Canada's immense peat resources, based on the report of this Commission, has now been undertaken by the Department of Mines. A large bog has been acquired by the Government, where peat fuel is being produced on a commercial scale by a method which has proved successful in European practice. In Ottawa a testing plant has been estabished, where an extended investigation of the production of gas power from peat is now under way. Finally, an examination of the most easily accessible peat bogs by the peat experts of the Department is in progress. It is reasonable to expect from this method of procedure the establishment on a sound financial basis of an extensive peat-fuel industry.

The expectation is strengthened by a perusal of Dr. Eugene Haanel's recent address before the American Peat Society, which sets forth the principles guiding the Canadian authorities and the economic situation of Canada as regards fuel supply. The Commission referred to above found that all endeavors to accomplish economically by artificial means in a short time what has been accomplished by nature in exceedingly long periods of time, namely, the changing of peat into a substance similar to coal, have so far not led to commercial results, and after trial have been abandoned. It has been decided, therefore, to introduce only such processes and such machinery as have proved commercially successful in Europe, leaving experimentation and the development of new ideas to the future, when the peat industry has been placed on a secure basis. To quote Dr. Haanel:

"To re-establish the confidence of the people of Canada in the value of peat as a domestic and industrial fuel, and to stimulate renewed activity in the development of our peat resources, the Government has acquired 300 acres of peat bog, with an average depth of 9 feet, for the purpose of manufacturing peat fuel on a commercial scale, and by a method which has proven successful in European practice. At this plant interested parties will have an opportunity of ascertaining for themselves the working of the bog as well as the suitability of the peat fuel produced. The capacity of our plant is a production of 30 tons per day. For a large commercial plant, mechanical excavators should replace the manual labor empoyed at our plant, if the bog to be exploited is suitable for this class of labor-saving machinery.

"The plant at Alfred is to serve as a model of a successful process, and not for the production of peat fuel on an extensive scale. We expect, however, to manufacture during this season, about 2,000 tons of peat fuel, part of which is to be used in our peat gas producer at Ottawa. Allowing 140 days for a season's operation, the cost per ton of air-dried machine peat, including interest on capital invested, amortisation, oil and repairs, is as follows:

Cost of fuel on the field	$1.40
Cost of fuel stored in shed	1.65
Cost of fuel loaded on car	1.65
Cost of fuel in stack	1.70

By the employment of mechanical excavators and the manufacture of peat on a large scale, the cost of production per ton should be considerably less than the figures here given.

"The objection to the air-drying process, practiced at our plant, is that it is not a continuous process, that it can be worked only during the summer months, and that the amount of fuel which can be produced during one season is dependent upon weather conditions. These statements are quite true, and yet Sweden, Finland, Denmark, Germany, Holland, Austria, and Russia depend for a large part of their fuel supply on the simple process of pulping the peat, forming it into bricks upon the field and harvesting it as air-dried fuel. The weather conditions in Canada are as favorable, if not more so, for the production of air-dried machine peat as in the countries mentioned. To prevent shortage of peat fuel on account of unfavorable weather conditions during a season's work, a year's supply of peat fuel should always be kept in storage. . . . .

"The economy which may be effected by the use of peat is readily understood when it is stated that in Ontario and Quebec the average price of anthracite with a high percentage of ash, is $7.50, and in Manitoba $10.00 per ton, whereas air-dried machine peat, containing only about 5 per cent. of ash can be manufactured at a cost of considerably under $3.00 for an amount having the same calorific value as a ton of the anthracite we import. This could be sold at places conveniently situated as regards transportation facilities and not too far from the place of manufacture for a little more than one-half the price paid for anthracite in Ontario and Quebec, and for a little more than one-third of the price paid for anthracite in Winnipeg.

"Some few years back the labour troubles in the United States taught us a lesson which should be heeded, and which should enable us to conceive what a real fuel famine would mean for Canada. Anthracite coal in Ottawa at that time was sold at $12.00 per ton. What if it could not be got at any price, and if we had to pay the transportation costs of fuel from either Nova Scotia or the far West? Who can even imagine the suffering it would entail upon our population? It is very easy to say that such a state of affairs is not likely to occur, but who will guarantee that it might not? The central provinces of Canada have accumulated no stores of fuel ready to be drawn upon in cases of emergency. We import what we need from year to year, and any shortage of supply from whatever cause affects seriously our industries and the comfort of our people.

"We cannot afford, in the light of past experience, to waste capital on the experimentation for the discovery of processes which shall be continuous in operation and furnish a fuel from peat similar to coal, nor can we wait until someone at some time in the future will invent such process and demonstrate its commercial possibilities. Neither should prospective manufacturers listen to the marvellous representations made by promoters of schemes and processes, which promise great profit for production at excessively low costs of a peat fuel superior to anything yet put upon the market, but wisely adopt processes which are already an assured commercial success in the peat-using countries of Europe.

"The peat bog at Alfred was acquired by the Government for the purpose of demonstrating to prospective manufacturers of peat fuel one of these processes, and to prevent failure from choosing bogs unsuitable for their purpose the Mines Branch has recently undertaken a systematic investigation of the more easily accessible peat bogs. In carrying out this investigation, our peat expert has been instructed to determine and map their extent, ascertain their depth, and also the quantity, character, and calorific value of the peat contained in them. So far, twelve bogs have been investigated, mapped, and reported upon. In case of need, the staff performing this work can be increased to meet the requisitions made upon the department.

"The successful inauguration of a peat fuel industry in Canada may be looked forward to with confidence if, content to accept European practice, we establish peat plants at strategic points on the workable bogs scattered throughout the farming regions of those provinces which require to import coal, and operate them in the interests of the neighbouring communities. This will avoid long hauls, for which air-dried machine peat is not fitted. . . . . . .

"To demonstrate the value of peat for the production of power for industrial purposes, a modern German peat-gas power plant has been erected by the department in Ottawa. Its capacity is 60 horse power, and consists of a double fire zone Körting peat-gas producer, with the necessary gas-cleaning apparatus, and a Körting four-cycle single-acting gas engine direct connected to a Westinghouse 50-kilowatt direct-current generator. While no definite figure can at present be given of the consumption of peat per brake horse-power hour, since the investigation begun some time ago is not yet completed, our preliminary trials, however, bear out the results obtained in Swedish and German plants, where the amount of peat consumed per brake horse-power hour ranges from a little over 2 pounds to about 3 pounds, depending on the calorific value of the peat employed. Since the peat of the different bogs so far examined has a high calorific value, we expect that our figure for the consumption of peat per brake horse-power hour will be in the neighbourhood of 2 pounds.

"The erection of gas producers designed for the recovery of by-products is not recommended except in localities where such by-products would command a ready and profitable market. In Canada it is far more economical to aim at the complete gasification of all the heat elements in the fuel. Peat-gas producers for power purposes should, whenever possible, be erected on the bog, and the energy generated in the form of electricity transmitted to neighbouring towns and villages for power and lighting purposes as in the case of water power. This is the policy adopted in European countries. Whatever other valuable products may be obtained, such as moss litter, peat mull, alcohol, packing paper, millboard, ammonia and nitrates, the great and important need for us in Canada is the production from the peat deposits of a reliable supply of fuel for domestic and industrial purposes.

"When this has been attained and peat fuel is put on the market in abundance and sold at a reasonable price, we shall not alone have rendered ourselves to a great extent independent of outside sources for this necessity, thus enabling us to retain in our own country a large part of the capital now spent annually for the purchase of fuel from abroad, but a new era of industrial development will dawn upon our nation, and we shall here see repeated what has been accomplished in Europe—the establishment of large industrial concerns on the waste areas of our country underlaid by peat, and the wide stretches of these solitudes will become resonant with the welcome sounds of industrial activity."

FAILURES OF GAS ENGINE CYLINDERS.

A DISCUSSION OF THE CAUSES OF CRACKS IN GAS ENGINE CYLINDERS AND METHODS OF PREVENTION AND REPAIR.

Prof. Langer—International Mining Congress.

THE difficulties of gas-engine cylinder design, which has always been the greatest of the mechanical problems connected with the combustion motor, have been successfully solved so far as small and moderate-sized units are concerned, but the cylinder still remains the weak point of engines of really large dimensions. Improvements in construction and reduction of the working pressure have considerably lowered, but by no means removed, the danger of cracking. Dugald Clerk, in a paper reviewed in these columns in The Engineering Magazine for November of last year, expressed the opinion that a new thermodynamic cycle will have to be adopted for large gas engines before any permanently successful development can take place. Prof. Langer, who reviewed recent experiences in working large gas engines in Europe at the recent International Mining Congress at Düsseldorf, suggests that the solution of the problem depends upon the production of a material of which the product of the co-efficient of expansion and the modulus of elasticity is lower than in the case of cast iron, without sacrifice of tensile strength. We quote at length from Prof. Langer's comments on cylinder cracking, after an abstract of his paper in the *Iron and Coal Trades Review* for August 26.

"The uncertainty still prevailing as to the actual cause of cracking is evident from the circumstance that some makers turn out jacket and cylinder in one piece, whilst others build up both from parts. The latter type of construction has arisen chiefly from the desire to obviate axial casting stresses, which place the inner cylinder in tension, as also from the endeavor to secure compactness in the metal at the admission and exhaust connections. On the other hand, the first-named type gives an improved transmission of strains between the cylinder and the engine frame or intermediate piece. This type preponderates in Germany, but in America about 40 per cent. of the engines have built-up cylinders, divided at right angles to the axis. As a matter of fact, the built-up cylinders have remained free from cracks due to tension stresses, whereas the solid type frequently exhibits cracks between the head flange and the cylinder flange. A close investigation of the cause, however, shows that the dangerous flexion stresses have been overlooked in the desire to protect the flexibility of the wide flanges, which stresses are set up at the rounded junction between cylinder and flange, by any axial force acting in the cylinder. This defect, which is not inherent in the single-piece cylinder, is absent in the built-up cylinder, the seat of danger being of stronger construction for other reasons, and all dangerous stresses between head and cylinder being prevented by suitable packing. For extraneous reasons the flexion stresses at the seat of danger are so different in the two classes of cylinder that the appearance of cracks in the single-piece cylinder is no proof of the danger of casting stresses; and, indeed, the examination of single-piece cylinders that have been broken up has demonstrated the harmlessness of axial casting stresses, the cracks being invariably formed where the cylinder and junction had been further weakened by a considerable displacement of the core. Though the stresses would necessarily be greater in the thicker portions of the metal where the core had been displaced, the cracks always appeared in the thinner places, which had been subjected to excessive mechanical strain.

"The causes producing cracks in the walls of the combustion chamber are of an essentially different character. The fact that these cracks always form in places where the transmission of heat to the cooling water has been obstructed in some way indicates that their immediate cause is to be sought in the stresses arising from inequality of temperature in different strata of the wall at that place. At such places the maximum temperature of the metal nearest the combustion chamber will greatly exceed the normal during the expansion and exhaust strokes, so that compression stresses are set up in the hotter strata and tension streeses in the cooler strata. During the two strokes aforesaid, the state of stress of the metal is comparable with that of a bar that is bent toward the inside of the cylinder. On the intake valve being opened, cold air enters, and cools the inner surface of the combustion chamber, whereas the central portion of the metal is not cooled to anything like the same extent. Consequently the surface metal is subjected to a considerable tension, the effect being similar to that produced by a sudden bending outward to an extent proportional to the product of the greatest momentary difference in temperature between the surface and centre of the metal, and the co-efficient of expansion of the metal. The stresses are the product of the difference of temperature, co-efficient of expansion and the modulus of elasticity.

"It would be difficult to find another example of such unfavorable stress, owing to the rapidity with which the injurious changes of temperature succeed one another in the gas-engine cylinder; and the actual extent of the stresses cannot be calculated, owing to the impossibility of ascertaining exactly the distribution of temperature in the walls during the various phases of the complete cycle of the engine. If, however, it be remembered that a difference of 100 degrees C. in temperature produces a stress of over 14,000 pounds per square inch when the longitudinal expansion of the metal is prevented, it can only be a matter for surprise that such cracks are not even more frequent. The formation of a crack of only a few millimetres in depth is sufficient to relieve the stress, so that if observed in time, the extension of the cracks can be prevented by chiselling, drilling and stemming with soft copper. This, however, is unavailing when the crack has penetrated deeper, the high co-efficient of expansion of the copper then tending to burst upon the crack. On the other hand, the cracks are difficult to locate in the early stages, since they do not gape when the metal is cold; and therefore preventive measures must be adopted, viz., reducing the differences of temperature in the wall to an innocuous degree. This involves the suppression of irregular ignition and incomplete combustion on the one hand, and the improvement of heat conductivity on the other (avoidance of any accumulation of material that can lead to the formation of cavities and so lower the conductivity). Other features to be strictly avoided are highly convex junctions, which accumulate heat on the one hand and are particularly exposed to the cooling action of the incoming air on the other, both of which conditions predispose to the formation of cracks. It is therefore evident that the bulbed shapes of the admission and exhaust connections—which result in convex junctions with the cylinder, and are solely designed to take up the force of the explosion and to shorten the length of the engine—are unfavorable so far as the combustion chamber is concerned.

"The inevitability of rapid changes of temperature during the working cycle of the engine, and the impossibility of obtaining perfect equality in the transmission of heat to the cooling water in all parts of the combustion chamber walls, preclude absolute success in preventing cracks and necessitate the attempt to reduce the factor resulting from the product of the co-efficient of expansion and the modulus of elasticity of the metal. The problem will be solved when a material is produced in which this factor is lower than is the case with cast-iron, without sacrifice of tensile strength; and when that is achieved, the life of the gas-engine cylinder will be equal to that of the steam-engine cylinder. The failure of the endeavours to supersede cast-iron by steel in gas-engine cylinders is due to the factor in question being about four times as great as in cast-iron, while the resistance of cast-steel to the alternating stresses is barely thrice that of cast-iron."

THE ECONOMICS OF RAILWAY ELECTRIFICATION.

A DEFENSE OF THE DIRECT-CURRENT SYSTEM AND A DISCUSSION OF THE POSSIBILITY OF STANDARDIZATION.

William Bancroft Potter—American Society of Mechanical Engineers.

LAST month we reviewed in these columns the paper read by George Westinghouse at the recent joint meeting of the American Society of Mechanical Engineers and the Institution of Mechanical Engineers, recommending the early adoption of a standard system of railway electrification for universal use. While Mr. Westinghouse expressly disclaimed advocacy of any particular system, his paper exhibits a quite natural partiality for the single-phase system, the most notable example of which, the New Haven terminal equipment, his company installed. Entirely different opinions, both as to the desirability of standardization and the relative merits of the direct-current and single-phase systems, were expressed by at the same meeting by William Bancroft Potter, of the General Electric Company, a part of whose paper is reproduced below.

"There would undoubtedly be an advantage," he says, "in having the character of the energy supplied to the contact conductor uniform, but this is out of the question on account of the great difference in the requirements of specific conditions, such as congested urban or suburban service and comparatively infrequent trunk line train movements.

"The sub-station and rolling stock may be equipped for operation with direct current or alternating current, single phase or three phase, and what is commonly spoken of as 'the system' usually refers only to that part of the general scheme of electrification which comprises the sub-station and rolling-stock equipment. There are exceptional cases where the power-station and transmission lines have direct relation to the rolling-stock equipments; but with the development of the alternating-current transmission this is less frequently the case than it was a number of years ago, when 600-volt power-stations supplied power directly for the operation of 600-volt motors.

"The development of apparatus for higher voltage direct current has so far increased its scope that direct current at either 600 voltage or higher may be considered the most economical for city and interurban service, and for the electrification of steam railways where the density of traffic is sufficient to require a relatively large investment for rolling stock, as compared with that required for the secondary distribution system and the sub-station apparatus.

"Single-phase and three-phase rolling-stock equipments are applicable only to exceptional conditions. The reason for this is the greater first cost of such equipments. This is especially true when comparing single phase with direct current. The type of equipment used on the rolling-stock may well be a more important factor in the economy of investment and operation that the scheme of power distribution.

"Under the conditions which exist in America, direct current and single-phase are applicable to either level or grade work; while three-phase will probably be limited to the latter where its regenerative feature of returning energy to the line may be of value. The relative economy of the different systems of electrification is dependent on the density of traffic and the character of power available, rather than on the length of the railway.

REASONABLE VALUES FOR TRUNK-LINE SERVICE.

SUB-STATIONS.

	600 v. D. C.	1200 v. D. C.	11,000 v. 1-Phase.	11,000 v. 3-Phase.
First cost per kilowatt complete	$26	$28	$11	$12
Comparison of installed kilowatt, per cent......	200-250	100-125	100	100-125
Load factor, machines in service, per cent...	20-40	35-70	40-80	30-60
Average efficiency, per cent...	78-88	87-92	97-98	97-98
Yearly operation and maintenance, each station	$5,000	$5,000	$2,500	$2,500

CONTACT CONDUCTORS.*

	Third Rail.		Overhead.	
First cost, per mile	$5,000 to 7,000	$5,500 to 7,500	$3,500 to 7,000	$4,500 to 8,000
Efficiency, per cent	88-92	90-96	93-97	93-97
Maintenance per mile per year.	$75-125	$100-150	$100-200	$125-250

---

* Variation in cost of third-rail due to different weights of rail which may be required. Variation in cost of overhead due to variation in the class of construction, such as with wooden poles or with steel bridges.

ROLLING STOCK.†

	600 v. D. C.	1200 v. D. C.	11,000 v. 1-Phase.	11,000 v. 3-Phase.
Locomotives.				
First cost, each	$44,000	$47,500	$64,000	$58,000
Weight, tons (2,000 lb.)..	125	125	160	160
Average efficiency, locomotive wheels to trolley, per cent	85	85	79	81
Maintenance per locomotive mile, cts.	4	4	8	5
Motor-Cars (complete).				
First cost, each.	$12,000	$13,500	$20,000	
Weight, tons (2,000 lb.)..	43	44	54	
Average efficiency, wheels to trolley, per cent	82	81	73	
Maintenance per car-mile, cents	2	2.2	3.5	

---

† Other weights of locomotives will cost, more or less, about in proportion to their weights. With gearless direct-current locomotives, the average efficiency of locomotive wheels to trolley is approximately 88 per cent.

"In cases where purchased power is used, or is depended on as a reserve, the frequency of the current supplied by the power company will have a bearing on the cost of sub-stations, and will thus affect the choice of the system. For direct-current operation, rotary apparatus is used for converting the alternating into direct current, and the frequency of the supply is therefore relatively unimportant. For single phase operation under the usual conditions a frequency of not more than 15 cycles is desirable; and to provide this frequency, rotary frequency changers are as necessary as are rotary converters in the case of direct current, since the frequency of existing power companies ranges from 25 to 60 cycles.

"With power supplied at the proper frequency for single-phase operation permitting the use of static transformers and dispensing with frequency changers, the amount of energy required for a given trunk-line service is in many cases nearly the same as for direct current, the greater weight of the equipped rolling stock, and the lower efficiency of the single-phase equipments, off-setting the rotary converters and trolley-line or third-rail losses of the direct current.

"The principal conditions which determine railway equipment are:—

(*a*) Profile of road.

(*b*) Transportation required—*i. e.*, weight of trains or seating capacity of cars.

(*c*) Frequency of trains.

(*d*) Length of individual runs or distance between stops.

(*e*) Schedule required.

(*f*) Length of railway to be electrified.

"In the selection of the electrical system best adapted to a particular set of conditions there are three items to be considered:—(*a*) sub-stations, (*b*) contact conductors, (*c*) rolling-stock. A comparison of these items determines the relative economic values of the systems. There are certain features under each of these items which may properly be examined. For trunk-line service the values in the table will be found within reasonable limits for the usual requirements.

"We will consider briefly the effect of changes in the above items.

(*a*) *Profile.*—From a level country to a limiting grade of 1 or 1½ per cent. there will be little difference in the relative values of the systems. With steeper grades the conditions will be more favourable for alternating current.

(*b*) *Traffic Requirements.*—Heavy individual train-units favour the alternating-current system with exception of the locomotives; light trains or multiple-unit operation favour the direct-current system.

(*c*) *Frequency of Trains.*—Infrequent service with a relatively small number of locomotives favours the alternating current, frequent service the direct current. With increase in number of trains, the direct-current systems gain relatively faster than the alternating current in economy of operation, due to relatively decreased sub-station operation, increased sub-station efficiency, and lower cost of equipment maintenance. It is therefore well to consider what the ultimate traffic density may be, and select the system best suited to meet these requirements.

(*d, e*) *Distance between Stops and Schedule Required.*—Variations in these will not affect the relative value of systems unless extreme requirements, such as high schedule speed with short runs, make the use of direct current imperative.

(*f*) *Length of Road.*—For a similar character of service throughout the railroad may be of any length without affecting the relative desirability of the various systems. What is suitable for the first 50 miles will be equally suitable for any extension.

"An examination of these variables will show that a change in the conditions to be met will radically change the relative economic value of the systems of electrification. The single-phase system, by reason of the apparent simplicity of its elements and the utilisation of higher potential for the contact conductor than is possible with direct current, is admitted very attractive. There is the other side to the question, that it is impossible to build a single-phase commutating motor comparable in first cost and maintenance with a direct-current motor. Over this subject of alternating-current single-phase *v.* direct-current systems there has been a great deal of controversy. It is our opinion that comparative results obtained up to the present time are in favour of direct current.

"Desirable as would be a standard system for all classes of service, we cannot hope to establish such a standard should it impose an additional expense without adequate return. A summing up of all the elements of each electrical system will generally lead to a definite showing of which system is most desirable to meet specific conditions. For trunk-line service a higher potential than 600 volts will unquestionably be used; 1,200 volts direct current will prove economical in some cases, but a still higher voltage is required to provide economically for the heavier intermittent service. Whether this potential will be 1,800 or 2,400 volts direct current or 11,000 volts alternating current cannot be settled arbitrarily."

In the second part of his paper Mr. Potter deals with interurban railways and examines a typical case in which the conditions are favourable to single-phase operation. Here too he finds the direct-current system superior. "An examination of the elements which enter into the first cost and operation of a system will show at once that as the density of traffic increases there is a rapid gain in the relative advantage of the direct-current over the single-phase system. The saving effected by the 1,200-volt direct-current system is so marked that a great increase in the adoption of this potential for this class of interurban railroading may be anticipated, and, on the other hand, it will not be surprising if the single-phase interurban system is entirely discarded in America, unless some marked improvement is made in the art, and a more economical equipment made available. There is no question regarding the mere movement of trains by any particular system—this may be taken for granted. The study of electrification is really a problem in economic engineering, and not simply a technical problem."

EUROPEAN LOCOMOTIVES FOR VERY HIGH SPEEDS.

A SUMMARY OF THE CHARACTERISTICS OF LOCOMOTIVES FOR RUNNING SPEEDS ABOVE SIXTY-TWO MILES PER HOUR.

M. Courtin—International Railway Congress.

WHEN the International Railway Congress met in Paris in 1910, regulation speeds of 90 kilometres (56 miles) per hour were to be found on comparatively few railways, and speeds higher than this were exceedingly rare. The report on locomotives for very high speeds, presented at the Eighth Session, held at Berne last July, by M. Courtin of the Baden State Railway, shows that speeds of 100 kilometres (62 miles) per hour and even higher occupy much the same position now, in Europe at least, as the speed of 90 kilometres occupied 10 years ago. On ten European railways, exclusively in France and Great Britain, regulation speeds of 100 kilometres per hour are attained in regular service, on several other lines this speed is reached under exceptional conditions, while still other railways possess locomotives capable of attaining this speed, although their full power is never used. We give below a brief summary of the characteristics of European locomotives for speeds exceeding 100 kilometres per hour taken from M. Courtin's report, which is printed in the *Bulletin* of the Congress for June.

"In Europe, speeds of 100 kilometres per hour are only attained in regular working, up to the limit of 129 kilometres (80.2 miles) per hour, on the Eastern, Northern and Orleans Railways of France, and the Caledonian, Great Eastern, Great Western, Lancashire and Yorkshire, Midland, North Eastern, and South Eastern Railways in Great Britain; in addition, speeds of up to 120 kilometres (74.5 miles) per hour are attained in exceptional cases, such as lateness, etc., on the Belgian State Railway, Baden State Railway, the P. L. M., Midi and State Railways in France and the Great Central in Great Britain.

"As regards the locomotives used for attaining these high speeds, by far the most usual arrangement is to have a leading bogie; the different types of the kind used are 2A1, 2B, 2B1, 2B2, 2C and 2C1. On a few railways, we also find locomotives with only one leading carrying axle, for instance, the 1B locomotives of the Paris-Lyons-Mediterranean Railway and on the Great Western Railway, as well as the 1C1 tank locomotives of the latter railway. This locomotive, and also another 2B1 type, also on the Great Western Railway, are the only tank locomotives reported for speeds exceeding 100 kilometres (62 miles) per hour.

"The bogie trucks or leading carrying axles all have more or less lateral play; the return to the central position is ensured by such well-known means as check springs, swing links, etc. On most railways, the trailing carrying axles also have lateral play; this is only absent in a few cases. On several English railways, the driving axles have also a little lateral play.

"As regards the number of cylinders, two-cylinder and four-cylinder locomotives are represented approximately equally, but among the locomotives most recently built there are more four-cylinder locomotives; locomotives with three cylinders are only used to a limited extent, on two English railways, for the purposes here considered. As regards countries, the two-cylinder locomotive predominates in England, while but few of these locomotives are used on Belgian, German, French and Swedish railways. The opposite is the case with four-cylinder locomotives, which are more common on the railways on the continent of Europe, particularly in France. The two-cylinder locomotives have inside cylinders in the great majority of cases; in only about 10 per cent. of the locomotives reported are the cylinders outside.

"The four-cylinder locomotives have two inside and two outside cylinders, without exception. There are no cases of designs with cylinders placed one over the other, or placed one behind the other and acting on the same cross-head (Vauclain or tandem type). As far as four-cylinder compounds are concerned, the low-pressure cylinders are inside and the high-pressure cylinders outside, in the majority of the locomotives. On the French railways, the rule is that the low-pressure cylinders are inside. The Italian locomotives reported have the two high-pressure cylinders on the left, and the two low-pressure cylinders on the right side of the locomotive, one being inside and the other outside in each case. The three-cylinder locomotives, which are all compounds, have one inside high-pressure cylinder and two outside low-pressure cylinders.

"The two-cylinder locomotives are chiefly non-compounds; especially is this the case with the Swedish and English locomotives of this kind, which are all non-compounds. On the contrary, compounding predominates in the case of four-cylinder locomotives; there are only two varieties which are exceptions. The two varieties which have four cylinders and are non-compounds (Belgian State Railway and Great Western Railway), both use superheated steam.

"Low pressures, of from 10 to 12 atmospheres, are only found in a few cases; medium pressures, of nearly 13 and of 14 atmospheres, are more frequent, particularly in the case of the English locomotives, where 12.7 atmospheres is the rule. The highest pressures, of 15 and 16 atmospheres, are found on nearly all the French and German locomotives, and also on Belgian, Danish, Italian and Hungarian locomotives; but there are only very few instances in the case of English locomotives.

"The older wet-steam principle is the rule; superheated-steam locomotives form the exception. Taking it altogether, only two Belgian, four German, one English and one Swedish superheated-steam locomotives have been reported; several administrations are at present building superheated-steam locomotives for high speeds. The German superheated-steam locomotives are all four-cylinder compounds; all the other superheated-steam locomotives are non-compounds, and have either two cylinders (Belgium and Sweden), or four (Belgium and Great Britain).

"As regards size, boilers having a heating surface of from 150 to 250 square metres (1,614.65 to 2,691.08 square feet), and even more, are by far the more usual. Smaller boilers, of heating surfaces down to 100 square metres (1,076.43 square feet), are rare exceptions. The grate area varies considerably; it is evident that this is much influenced by the quality of the fuel; this is shown by the comparatively small grates of the English locomotives, and of some of the Continental locomotives which use English coal. The length of the grate, on the large majority of the locomotives, does not exceed 2.5 metres (8 feet 2 7/16 inches). Grates longer than 3 metres (9 feet 10 inches) are only found in very few cases. When a larger grate is required, the plan generally adopted is to have a wider fire-box, either standing on the frame between the wheels, or also extending beyond them.

"Most of the railways use smooth tubes having an external diameter of 45 to 55 millimetres (1 25/32 to 2 5/32 inches). Wider tubes with ribs inside (Serve tubes) predominate on the French locomotives, and are also used on one Belgian locomotive. The length between tube-plates does not as a rule exceed 5 metres (16 feet 5 inches). Lengths of nearly 6 metres (19 feet 8 inches), or a little more, are used in a few cases. The length of the ribbed tubes varies as a rule between 3.5 and 4.5 metres (between 11 feet 6 inches and 14 feet 9 inches).

"On the four-cylinder locomotives, the connecting rods either all act on the same driving axle (as a rule the first), or those of the inside cylinders act on the first and those of the outside cylinders on the second, the two being connected by coupling rods (de Glehn design). The latter design is used on all French, on some of the Danish, and on one of the English four-cylinder locomotives, while the single-axle drive is found on the Belgian, on the German, on the Italian, on the Hungarian and on one of the English four-cylinder locomotives.

"The weights of the locomotives, in working order, vary much, according to design; the lowest figure is 43,000 kilograms (94,800 pounds), for the 2B two-cylinder locomotive of the French Northern Railway, and the highest is 90,400 kilograms (199,300 pounds), for the 2C1 four-cylinder locomotive of the Midi Railway. The adhesive weights, in the case of locomotives with two driving axles, vary between 28,600 and 39,800 kilograms (between 63,050 and 87,740 pounds) (2B two-cylinder locomotives of the French Northern Railway, and 2B three-cylinder locomotive of the Midland Railway). In the case of locomotives with three driving axles, the lowest adhesive weight is 42,470 kilograms (93,630 pounds) (2C locomotive of the French Northern Railway), and the highest 55,500 kilograms (122,350 pounds) (2C locomotive of the Great Western Railway). Axle-loads, on driving axles, of less than 15,000 kilograms (33,100 pounds) are only found in a very few cases. Most of the locomotives have axle-loads, on driving axles, of 16,000 to 18,000 kilograms (35,270 to 39,680 pounds). Higher axle-loads are to be found on some Belgian, French and English locomotives. The maximum, about 20,000 kilograms (44,100 pounds) in round figures, is found on the 2B locomotive of the Midland Railway.

"The figures for the area of heating surface per unit of weight in working order show much less variation. With very few exceptions, the figures per ton for the chief types lie within the following limits:

2B.......	2.24 to 3.5 sq. m. (24.48 to 38.26 sq. ft.)
2B1......	2.46 to 3.3 sq. m. (26.88 to 36.07 sq. ft.)
2C..	2.2 to 3.3 sq. m. (24.05 to 36.07 sq. ft.)
2C1......	2.77 to 3.1 sq. m. (30.28 to 33.88 sq. ft.)

The maximum in this respect is found on the 2B two-cylinder locomotive of the Great Eastern Railway, namely 4 square metres per ton (43.72 square feet per English ton).

"Appliances for reducing air resistance (wind-cutters) are to be found on locomotives of the Danish, German, French, Italian, Swedish and Hungarian railways. They mostly consist of a conical or wedge-shaped extension at the front of the smoke-box, and of a wedge-shaped cab front."

THE ENGINEERING INDEX

"THE KEYSTONE IN·THE·ARCH·OF·APPLIED·SCIENCE."

The following pages form a *descriptive* index to the leading and special articles of permanent value published currently in the Transactions of all the important engineering societies of both Europe and America, and in all the leading engineering journals of the world—in the English, French, German, Dutch, Italian, and Spanish languages.

The term *descriptive* is used because the definite purpose of each index note is to indicate clearly the character and purpose of the article or paper described; and with that in view we give the following essential information about every publication:

(1) The title of the article,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published,
(7) *We supply the article itself, if desired.*

☞ The full text of every article described in the Index, together with all its illustrations, can usually be supplied by us.—See the "Explanatory Note" at the end of the Index, where also the full titles of the principal journals indexed are given.

Note—The busy engineer will also observe that the Index is conveniently classified into the larger divisions of engineering science, to the end that the reader may quickly turn to what concerns himself and his special branches of work. By this means it is possible, within a few minutes' time each month, to learn promptly of every important article published anywhere in the world, in any language, upon the subjects claiming one's special interest.

Divisions of The Engineering Index.

Civil Engineering..............Page 119
Electrical Engineering......... " 126
Industrial Economy............ " 131
Marine and Naval Engineering. " 133
Mechanical Engineering........Page 134
Mining and Metallurgy........ " 146
Railway Engineering........... " 154
Street and Electric Railways.. " 157

CIVIL ENGINEERING.

BRIDGES.

Abutments.

Concrete Pedestal Bridge Abutments on the New York State Barge Canal. Illustrates and describes a novel type. 800 w. Eng News—Aug. 18, 1910. No. 16429.

Arches.

A Plate Girder Arch Bridge Carrying a Concrete Roadway. Illustrated description of a bridge on the Buffalo grade crossing improvements 1200 w. Eng Rec—Aug. 20, 1910. No. 16445.

An Unusual Bridge Job: Putting a Center Hinge in a Two-Hinged Steel Arch. Brief illustrated description. 500 w. Eng News—Aug. 25, 1910. No. 16631.

A Reinforced-Concrete Arched Roof Over a Part of the Saint Martin Canal, Paris (Converture d'une Partie du Canal Saint-Martin, à Paris, par une Voûte en Béton armé). M. Mesnager. Detailed description of the work. Ills. Serial. 1st part. 5500 w. Génie Civil—July 30, 1910. No. 16552 D.

Cantilever.

The Main Street Bridge Over the Buffalo Belt Line. Illustrated description of a single-span skew cantilever bridge with protected steel work and a solid concrete floor. 1500 w. Eng Rec—Aug. 27, 1910. No. 16670.

Concrete.

Building a Concrete Railroad Bridge Under Traffic. Brief illustrated description of a bridge in Philadelphia to carry the Philadelphia & Reading Railway over Belfield Ave., and the method of construction. 1000 w. Eng Rec—Aug. 20, 1910. No. 16441.

Foundations

The Substructure of the Dumbarton Point Bridge. Illustrated description of difficult construction work in a recently completed double-track bridge on the Southern Pacific across lower San Francisco Bay. 2500 w. Eng Rec—Aug. 13, 1910. No. 16323.

The Substructure of the American River Bridge. Illustrated description of difficult work in California, carried out by the Southern Pacific Co. 2000 w. Eng Rec—Aug. 27, 1910. No. 16664.

Lift Bridges.

Erection of an Eight-Track Rolling Lift Bridge. Illustrates and describes difficult work in Chicago in replacing old fixed structures by new movable structures, without interrupting railway traffic 2000 w. Eng Rec—Aug. 13, 1910. No. 16332.

Piers.

A Tall Reinforced Concrete Bridge Pier. Illustrated description of a pier 165 ft. high, built in the Willamette River, near Portland, Ore. 1600 w. Eng Rec—Aug. 6, 1910. No. 16219.

Reinforced Concrete.

Three - Hinged Reinforced - Concrete Arch Bridge, Los Angeles. Illustrated detailed description of the design and construction. 2500 w. Eng Rec—Aug. 13, 1910. No. 16327.

Steel.

The Miles Glacier Bridge. Explains conditions that were met in constructing the Copper River & North Western Ry. in Alaska, and describes the bridge and its construction. 2500 w. Eng Rec—Aug. 6, 1910. No. 16217.

The Steel Superstructure of the Baumgarten Bridge near Potsdam (Eiserner Ueberbau der Baumgartenbrücke bei Potsdam). F. Eybächer. Illustrated detailed description. Serial. 1st part. 2500 w. Zeitschr d Ver Deutscher Ing—July 23, 1910. No. 16786 D.

See also Arches, under Bridges.

Viaducts.

Mission Bay Viaduct; Southern Pacific. Illustrations with brief description. 300 w. Ry Age Gaz—Aug. 19, 1910. No. 16461.

CONSTRUCTION.

Bore Holes.

Tests of Bore-Hole Linings (Versuche mit verschiedenen Bohrlochauskleidung). F. v. Emperger. Discusses results of tests of linings consisting of two wrought-iron pipes with the annular space between them filled with cement mortar. Ills. Serial. 1st part. 2500 w. Beton u Eisen—July 2, 1910. No. 16764 F.

Concrete.

Concrete Construction in the Philippines. Monroe Woolley. Illustrates and describes buildings erected, and other uses made of concrete. 1200 w. Cement Age—Aug., 1910. No. 16387.

Concrete Building with Steel Columns in the Lower Stories. Illustrates and describes the construction of a five-story building in Hoboken, N. J., used exclusively for the baking of bread. 2000 w. Eng Rec—July 30, 1910. No. 16061.

Concrete Mixers.

Concrete-Making Machinery. Vere Sussex Hyde. Illustrated descriptions of a number of machines. 2500 w. Surveyor—Aug. 19, 1910. No. 16695 A.

Earth Pressures.

Pressure Resistance and Stability of Earth. Discussion of the paper by J. C. Meem. 5000 w. Pro Am Soc of Civ Engrs—Aug., 1910. No. 16645 F.

Foundations.

Foundations for the Northwestern Railway Terminal Building, Chicago. Maurice Deutsch. Illustrated description of difficult work. 1200 w. Sch of Mines Qr—April, 1910. No. 16476 D.

Artificial Foundations in Austrian Cities (Praktische Erfahrungen über künstliche Fundierungen in verbauten Stadtgebieten Oesterreichs). Richard Kafka. Illustrated description of systems in use. Serial. 1st part. 1500 w. Zeitschr d Oest Ing u Arch Ver—July 22, 1910. No. 16757 D.

Compress Foundations at the New Gas Works in Lausanne (Applications du Système Compressol aux Fondations de la nouvelle Usine à Gaz de la Ville de Lausanne). P. Ossent. Describes foundations for furnaces, stacks, and a water tower. Ills. 1000 w. Bul Tech d l Suisse Romande—July 10, 1910. No. 16533 D.

Gasholders.

Steel Gasholder Tanks with Bulging Sides. Notes translated from a paper by Edouard Bonnet, describing tanks built in Germany. 3000 w. Eng Rec—Aug. 13, 1910. No. 16325.

Grain Elevators.

Reinforced-Concrete Grain Bins for the Storage Annex at Superior, Wis., Great Northern Ry. O. B. Robbins. Illustrates and describes the design and construction of these storage bins. 3000 w. Eng News—Aug. 4, 1910. No. 16171.

A Grain Elevator in Bremen (Getreidesilo in Bremen). E. Lufft. Describes an important reinforced-concrete structure. Ills. 1700 w. Beton u Eisen—July 2, 1910. No. 16762 F.

Reclamation.

See Dikes, under Waterways and Harbors.

Reinforced Concrete.

Reinforced Concrete. Arthur C. Auden. From a paper read at the Roy. Inst. of Pub. Health Cong. Discusses the system of reinforcement, materials, uses, etc. 3500 w. Surveyor—Aug. 19, 1910. No. 16696 A.

Reinforced Concrete or Steel Construction (Eisenbetonbau oder Eisenbau). A reply to criticisms of concrete construction in an article by Herr Fischmann. 4000 w. Deutsche Bau—July 13, 1910. No. 16596 B.

Reinforced Concrete Work in New Zealand. B. W. Wilson. Illustrates and describes important structures in and about Auckland. 2000 w. Cassier's Mag—Aug., 1910. No. 16286 B.

Methods for the Computation of Reinforced-Concrete Flat Slabs. Louis F. Brayton. A discussion of a paper by Argus B. MacMillan, giving plan of floor slab designed by the writer. 1800 w. Eng News—Aug. 25, 1910. No. 16633.

Calculation of the Statically Indeterminate Frame Members in the New "Alter Teichweg" Refuse-Destructor Plant, Hamburg-Barmbeck (Berechnung des sechsfach statisch unbestimmten Eisenbeton-Hallenbinders der neuen Unrat-Verbrennungsanstalt "Alter Teichweg," Hamburg-Barmbeck). Max Bachner. Mathematical. Ills. 4000 w. Beton u Eisen—July 2, 1910. No. 16761 F.

Compound Bending and Torsion Stresses in Rectangular Beams of Reinforced Concrete (Sollecitazione composta di Flessione e di Torsione nelle Travi rettangulari di Cemento armato). Umberto Puppine. Mathematical discussion. Ills. 4000 w. Monit Tech—July 30, 1910. No. 16566 D.

See also Stairways, and Grain Elevators, under Construction; Tanks, under Water Supply; and Sea Walls, under Waterways and Harbors.

Retaining Walls.

Formulas for the Design of Gravity Retaining Walls. W. H. Rose, in *Prof. Mem.*, Corps of Engrs. Presents easily applied formulae for the use of engineers. 2000 w. Engng-Con—Aug. 10, 1910. No. 16273.

The Theory of Earth Pressure on Retaining Walls (Zur Theorie des Erddruckes auf Stützmauern). Otto Mohr. A criticism of Max Ritter's paper in *Schweizerische Bauzeitung* for April 9, 1910, with a reply by the latter. Ills. 2000 w. Schweiz Bau—July 23, 1910. No. 16598 B.

Roofs.

See Arches, under Bridges.

Stairways.

Reinforced Concrete Stairways (Kragkonstruktion aus Eisenbeton bei Unterbauten für Freitreppen). Herr Weidmann. Describes in detail the design of a reinforced-concrete stairway. Ills. 2000 w. Beton u Eisen—July 2, 1910. No. 16763 F.

Steel.

The Erection of the Gimbel Building, New York. Illustrations and description of the fireproof construction of a large building for commercial purposes. 2000 w. Eng Rec—July 30, 1910. No. 16057.

The Doe Memorial Library, University of California. W. L. Huber. Illustrated detailed description of a building costing about $1,000,000. 2500 w. Eng Rec—Aug. 27, 1910. No. 16667.

Structural Steel Details in the Ball Realty Building. Describes the construction of a steel cage office building on Fifth Ave., New York City, and the details made necessary by the condition of the soil and the foundations of an adjacent building. Ills. 2000 w. Eng Rec—Aug. 13, 1910. No. 16330.

See also Reinforced Concrete, under Materiials of Construction.

Swimming Pools.

The Carnegie Swimming Pool at Yale University. C. S. Farnham. Illustrated description. 1000 w. Eng News—Aug. 11, 1910. No. 16311.

Tunnels.

Construction Methods and Organization in Constructing the Buffalo Water Works Tunnel. Illustrates and describes the construction of a rock tunnel under Lake Erie, 6,000 ft. long, and a land tunnel, 4,300 ft. long. 10800 w. Engng-Con—Aug. 17, 1910. Serial. 1st part. No. 16439.

The New York Tunnel Extension of the Pennsylvania Railroad.—The Long Island Approaches to the East River Tunnels. George C. Clarke. Illustrated detailed description of the portion of this work extending from East Ave. to Thomson Ave., in Long Island City, covering a portion on which the line changes from an underground to a surface railroad, and the entrance to the Sunnyside yard. 11500 w. Pro Am Soc of Civ Engrs—Aug., 1910. No. 16642 F.

The New York Tunnel Extension of the Pennsylvania Railroad.—The Sunnyside Yard. Louis H. Barker. Illustrated detailed description of the terminal passenger yard in New York City, located on Long Island. 4000 w. Pro Am Soc of Civ Engrs—Aug., 1910. No. 16643 F.

The New York Tunnel Extension of the Pennsylvania Railroad.—The Lining of the Four Permanent Shafts of the East River Division. F. M. Green. Illustrated description of shafts to promote ventilation, to provide access and egress from the tunnels, to permit electric connections, and to provide for pump discharge. 2000 w. Pro Am Soc of Civ Engrs—Aug., 1910. No. 16644 F.

See also Sewers, under Municipal.

MATERIALS OF CONSTRUCTION.

Brick.

Modern Methods of Brick-Making. Alfred B. Searle. Considers bricks as a building material, their characteristics, and manufacture. Ills. 8000 w. Jour Soc of Arts—Aug. 12, 1910. Serial. 1st part. No. 16480 A.

Cement.

The Effect of Alkali Water on Cement Mortars. A. J. Fisk, Jr. Gives results of tests at the University of Wisconsin. Describes materials and methods and states conclusions. 1500 w. Eng News—Aug. 18, 1910. No. 16426.

The Behavior of Hydraulic Compounds in Sea Water. H. Burchartz. A report of investigations made by order of the Prussian Minister of Public Works, and the results. Ills. 3000 w. Eng Rec—Aug. 27, 1910. No. 16666.

Manufacture and Use of Slag Cement and Other Substitutes for Portland Cement. W. D'Rohan. Describes how substitutes for Portland cement may be made in places where the cost for cement would be prohibitive. Also editorial. 3300 w. Engng-Con—Aug. 24, 1910. No. 16620.

Concrete.

See Dams, under Water Supply.

Mortars.

Mortar for Masonry Dams (zur Frage des Talsperrenmörtels). Hermann Schmidt. Discusses the characteristics of mortars of various compositions. Ills. 6000 w. Oest Wochenschr f d Oeffent Baudienst—July 30, 1910. No. 16760 D.

Paints.

The Effect of Crystalline Pigments on the Protection of Wood. Henry A. Gardner. A study of paint tests, reporting bad results when the wood is not properly selected. Ills. 1200 w. Jour Fr Inst—Aug. 1910. No. 16378 D.

Reinforced Concrete.

See Corrosion, under ELECTRICAL ENGINEERING, Electro-Chemistry.

Steel.

Tests of Vanadium-Steel Eye-Bars. Brief report of tests made at the Ambridge works of the American Bridge Company. 600 w. Eng Rec—July 30, 1910. No. 16058.

Tests of Nickel Steel Riveted Joints. An account of tests made under the supervision of Prof. A. N. Talbot, for the Board of Engineers, Quebec bridge, giving details and results. Also editorial note. 5000 w. Eng Rec—Aug. 20 1910. No. 16440.

Timber Preservation.

Notes on Wood Preservation and Creosote Production in Europe. E. A. Sterling. A report of recent observations in Europe of preservative methods for the treatment of timber. Discussion. Ills. 7000 w. Pro Engrs' Club of Phila—July, 1910. No. 16394 D.

Preservative Treatment of Farm Timbers. C. P. Willis. Information of value to farmers concerning simple methods of preservation. Ills. 2500 w. Sci Am Sup—Aug. 27, 1910. Serial. 1st part. No. 16659.

Crude Oil Treatment of Ties. E. O. Faulkner. A report of the Bakersfield oil tests, the Ebano oil tests, and tests to determine water absorption immediately after treatment. 4500 w. Ry Age Gaz—Aug. 19, 1910. No. 16460.

Obligatory Timber Preservative Treatment (Ueber den obligatorischen Gebrauch von Holzkonservierungsmitteln im Hochbau). Basilius Malenkovic. An argument for making the preservation treatment of structural timber obligatory in Austria. 3200 w. Oest Wochenschr f d Oeffent Baudienst—July 16, 1910. No. 16759 D.

MEASUREMENT.

Cement Testing.

German Standard Specifications for Delivery and Testing of Portland and Iron-Portland Cement. Ills. 1500 w. Eng News—Aug. 25, 1910. No. 16635.

Rainfall.

The Determination of Rainfall over a Given Area (Sulla Determinazione delle Massime Pioggie Attribuibili ad una Data Zona). U. Massari. Illustrated description of methods. Serial. 1st part. 1500 w. Monit Tech—July 10, 1910. No. 16562 D.

Stream Gauging.

Measuring the Flow of Large Streams. Franklin Van Winkle. Explains how to obtain the area of the stream and also the velocity of flow by means of surface, sub-surface and rod floats. Ills. 5000 w. Power—Aug. 16, 1910. No. 16375.

Experiments on Small Weirs and Measuring Modules. J. C. Stevens. Illustrated description of experiments with reference to their accuracy and their suitability for every-day gaging work in irrigation canals. 7000 w. Eng News—Aug. 18, 1910. No. 16428.

Stream Flow at Single Cross Section. Franklin Van Winkle. Explains measurement by means of current pressure gages, velocity meters, and float wheels. Ills. 4500 w. Power—Aug. 30, 1910. No. 16736.

Surveying.

Field and Office Methods in a Triangulation and Plane-Table Survey of the Ducktown Copper Mining District. Benjamin H. Case. Describes the methods used in making the survey and map. Ills. 3000 w. Eng News—Aug. 18, 1910. No. 16427.

Photographic Surveying from Balloons (La Fotografia dall' Aerostato nelle sue Applicazioni Topografia). Cap. Tardivo. A complete description of the methods employed and of the possibilities. 5000 w. Ann d Soc d Ing e d Arch Ital — July 1, 1910. No. 16558 F.

MUNICIPAL.

Efficiency System.

Civil Service Efficiency System, Chicago. Describes the system to be applied. 2800 w. Eng Rec—Aug. 20, 1910. No. 16442.

Pavements.

Concrete Pavement Construction at Boise, Idaho. Describes methods and gives cost. 1100 w. Engng-Con—Aug. 24, 1910. No. 16621.

Some Costs of Street Paving Work at Baltimore, Md. Information from the annual report for 1909. 2500 w. Engng-Con—Aug. 10, 1910. No. 16274.

Testing Paving Stone with the Sand-Blast Machine (Beproeving van Straatsteenen met de Zandblaas-machine). M. E. H. Tjaden. Discusses the utility of the test and illustrates results. 4000 w. De Ingenieur—July 16, 1910. No. 16795 D.

Refuse Disposal.

Town Scavenging and Refuse Disposal. Hugh S. Watson. Discusses the utilization of residuals from refuse destructors. 1500 w. Munic Engng—Aug., 1910. No. 16390 C.

Disposal of City Refuse. Outlines the general methods adopted in Canada, illustrating an incinerating plant at Westmount. 5000 w. Can Engr—Aug. 25, 1910. No. 16689.

The Operation of the Seattle Refuse Destructor. Shows graphically the results obtained and gives information concerning the factors governing the operation. 1800 w. Eng Rec—Aug. 13, 1910. No. 16326.

Specifications for Determining Cost of Garbage Incineration. Gives specifications issued by the San Francisco Board of Public Works relating to tests and cost. Ills. 3500 w. Engng-Con—Aug. 24, 1910. No. 16622.

Disposal Methods for Manufactural Wastes. A review of various methods of trade wastes disposal taken from an article by Robert Spurr Weston, in *Cotton*. 3000 w. Eng Rec—Aug. 27, 1910. No. 16665.

Roads.

Dust Prevention on Public Roads. Reviews methods that have been tried. 1200 w. Sci Am—Aug. 27, 1910. Serial. 1st part. No. 16656.

Supplementary Reports on the 1907 and 1908 Dust Prevention and Road Preservation Experimental Work of the U. S. Office of Public Roads. Also experimental work in 1909. 13000 w. Engng-Con—Aug. 3, 1910. No. 16167.

Bituminous Roads—Mixed and Poured. George C. Warren. Paper for the Int. Road Cong., at Brussels. Presents the advantages and disadvantages of the pouring and penetration methods, and of the mixing methods. 2200 w. Engng-Con—Aug. 10, 1910. No. 16275.

The Use of Tar on Roads. A. D. Whittaker. Read before the So. Gas Assn. Information concerning the use of tar, giving experience at several places and explaining methods. Ills. 7000 w. Am Gas Lgt Jour—Aug. 29, 1910. No. 16688.

Petrolithic and Other Systems of Road and Street Improvements at El Paso, Tex. Extracts from a report by F. H. Todd, including statements regarding "petrolithic and oiled macadam." 1200 w. Eng News—Aug. 4, 1910. No. 16170.

Sanitation.

The Relation of Water Supply to Sewerage and Sanitation. Richard Read. Read before the Inst. of Munic. & Co. Engrs. Discusses the subject of waste and means of relieving water-works by arranging for obtaining water for flushing purposes and street watering from other sources. Discussion. 3500 w. Surveyor —July 22, 1910. No. 16134 A.

Rat Suppression for Plague Prevention in San Francisco, Cal. G. M. Converse. Report to the U. S. Pub. Health and Marine-Hospital Service. Also editorial. 2500 w. Eng News—Aug. 25, 1910. No. 16627.

Sewage Disposal.

Sewage Disposal of Seaside and Tidal Towns. A. J. Price. A detailed discussion of the conditions and requirements, suggesting remedies and methods of disposal. General discussion. Ills. 10000 w. Surveyor—Aug. 5, 1910. No. 16347 A.

A Series of Notable Reports on Sewage Disposal by Dilution at Rochester, N. Y. Also editorial. 11000 w. Eng News—Aug. 11, 1910. No. 16316.

Creek Improvement at Syracuse. Illustrated account of preliminary investigations, explaining the conditions, and describing novel features in plans and specifications. 2500 w. Munc Jour & Engr—Aug. 10, 1910. No. 16271.

The Sewage Disposal Works of Mount Vernon, N. Y. Plans and description of a system providing for the use of a screening chamber, settling tanks, sprinkling filters and secondary settling basins. 3500 w. Eng Rec—Aug. 20, 1910. No. 16446.

Sewage Disposal Works, North Attleborough, Mass. Illustrated description of works comprising two double hopper-bottom settling tanks and sixteen intermittent sand filters. 2500 w. Eng Rec—Aug. 27, 1910. No. 16669.

Operation of the Reading Sewage Purification Works. E. Sherman Chase. Gives detailed results of operation of the new sewage works which are of interest to those connected with similar work. 3300 w. Eng Rec—Aug. 13, 1910. No. 16329.

Sewage Disposal in the Vicinity of London, England. H. N. Ogden. Discusses points observed in a recent visit to about a dozen plants near London, and their application to American conditions. 3500 w. Eng Rec—Aug. 6, 1910. No. 16215.

Sewage Disposal Works at Bushey. Ernest E. Ryder. Illustrated description of works and treatment. 1500 w. Surveyor—Aug. 5, 1910. No. 16345 A.

Sewer Gauging.

Gauging Sewage Flow on New Jersey "Joint Outlet" Sewer. Describes the gauges used and the gauge chambers. Ills. 1000 w. Munic Jour & Engr—Aug. 24, 1910. No. 16646.

Sewers.

The Fourteenth Street Sewer Tunnel, Washington, D. C. Asa E. Phillips. Explains conditions which practically precluded open-cut work, and describes the method of doing the work in tunnel with two shafts. Ills. 1000 w. Eng Rec—Aug. 6, 1910. No. 16221.

Some Structural Details of the River Des Pere's Foul Water Sewer at St. Louis, Mo. Ills. 1400 w. Engng-Con—Aug. 3, 1910. No. 16168.

Street Cleaning.

Street Cleansing and Watering. F. H. Yabbicom. Compares methods that have been adopted in some of the large towns of England, Scotland and Ireland. 6000 w. Surveyor—Aug. 5, 1910. No. 16346 A.

WATER SUPPLY.

Analysis.

Field Assay of Water. R. B. Dole. Aims to show the uses and limitations of these methods. 3000 w. Eng News—Aug. 11, 1910. No. 16312.

Aqueducts.

Carrying Water Through a Desert. Burt A. Heinly. A finely illustrated account of the construction of the Los Angeles aqueduct. 6500 w. Nat Geog Mag—July, 1910. No. 16043 C.

Electric Power in the Construction of the Los Angeles Aqueduct. E. F. Scattergood. Outlines this great work, and gives illustrated description of the arrangements for supplying power for construction purposes, and its uses. 3300 w. Pro Am Inst of Elec Engrs—Aug., 1910. No. 16399 F.

Dams.

Cracks in Concrete Core-Wall of the Little Bear Valley Dam, California. Sections and description of cracks, believed to be temperature cracks. 1200 w. Eng News—Aug. 25, 1910. No. 16632.

St. Andrews Rapids Dam. H. P. Borden. Map, showing location, with illustrated description of a dam of the type known as a "Caméré curtain dam," the first to be constructed on the American Continent. 3000 w. Engr, Lond—Aug. 12, 1910. Serial. 1st part. No. 16604 A.

Stoney-Gate Dam in the Albula Canyon for the Hydro-Electric Power Plant of the City of Zurich, Switzerland. K. E. Hilgard. Illustrated detailed description of a dam with three openings closed by gates of the Stoney type. 1500 w. Eng News—Aug. 25, 1910. No. 16636.

Ireland.

The Water Supply of Smaller Towns in Ireland. J. H. H. Swiney. Read before the Roy. San. Inst. Discusses the quantity required, the sources of supply, and the main considerations of importance. 2000 w. Surveyor—July 22, 1910. No. 16135 A.

Irrigation.

The Rio Grande Irrigation Project. Newton Forest. Illustrated description of interesting features, including one of the largest reservoirs in the world. 2000 w. Sci Am Sup—Aug. 13, 1910. No. 16284.

The Region in Roumania Inundated by the Danube (La Région d'Inondation du Danube en Roumanie). L. Mrazek. Describes a system of irrigation similar to that of the Nile. 5500 w. Rev Gen d Sci—July 30, 1910. No. 16531 D.

Irrigation in the Agro Romano (Per l'Irrigazione dell Agro Romano). G. de Angelis d'Ossat. A plea for the application of irrigation to this secton of Italy. 5200 w. Ann d Soc d Ing e d Arch Ital—July 1, 1910. No. 16557 F.

Pipe Corrosion.

Poor Pipe Causes Red Water in Springfield, Mass. Report of George C. Whipple on an investigation made of the rusty condition of the hot water in numerous apartment houses, and the cause of the trouble. 4000 w. Eng Rec—July 30, 1910. No. 16056.

Pipe-Line Design.

Determination of the Resultant Angle in Laying Out Combined Bends for Pipe Lines. C. A. Jackson. Gives a graphical method and an analytical method, illustrating by example. Ills. 2000 w. Eng News—Aug. 11, 1910. No. 16313.

The Choice of a Formula for the Calculation of Conduits (Sulla Scelta di una Formula per il Calcolo delle Condotte d' Acqua). B. Benigni. A comparison of the various formulae. 2800 w. Ann d Soc d Ing e d Arch Ital—July 15, 1910. No. 16561 F.

Pipe Specifications.

Canadian Soc. of Civil Engineers' Standard Specifications for Cast Iron Water Pipe and Special Castings with Tables of Dimensions, Thicknesses and Weights as Presented by a Special Committee. Approved by the Council of the Society, June 11, 1910. 8000 w. Can Soc of Civ Engrs—1910. No. 16397 N.

Plymouth, England.

The Plymouth Water Undertaking. Frank Howarth. Read before the Inst. of Munic. & Co. Engrs. History of one of the oldest municipal water undertakings in England, with illustrated description of present works. Also discussion. 10000 w. Surveyor—July 29, 1910. No. 16241 A.

Purification.

Water Purification by Ozone. Describes briefly methods used in European installations, and a recent installation at Lindsay, Ontario, in accordance with plans by J. Howard Bridge, which eliminates the auxiliary units. 1500 w. Munic Engng—Aug., 1910. No. 16391 C.

Water Purification Plant, Putnam, Conn. Describes conditions and the plant for a town of about 8000 inhabitants. 2500 w. Eng Rec—Aug. 13, 1910. No. 16331.

Reservoirs.

Hill View Reservoir, New York. Illustrated description of the features of design and construction of a reservoir forming a part of the new Catskill supply for New York City. 1500 w. Munic Jour & Engr—Aug. 3, 1910. No. 16161.

Santiago, Cuba.

The Water Supply System of Santiago, Cuba. H. F. Cameron. Illustrated description of the first plant of a national sanitary system in Cuba. 1700 w. Eng Rec—July 30, 1910. No. 16062.

Siphons.

The Albelda Reinforced-Concrete Siphon on the Aragon and Catalonia Canal, Spain (Le Siphon en Béton armé d'Albelda sur le Canal d'Aragon et Catalogne, Espagne). Mariano Luiña. Describes its design and method of construction. Ills. 3300 w. Génie Civil—July 23, 1910. No. 16550 D.

Springs.

Observations on the Permanency of Overflow Springs. Henry Preston. Refers to conditions in England only, describing the springs and explaining their origin. Discussion. 3000 w. Surveyor—July 22, 1910. No. 16136 A.

Sterilization.

The Sterilization of Water by Chlorine and Ozone. G. Sims Woodhead. Read before the Roy. San. Inst. A report of experiments made in connection with the treatment of an English water supply. 3000 w. Surveyor—July 22, 1910. No. 16133 A.

Tanks.

A Reinforced-Concrete Pumping Cistern Sunk Into Place in the Ground. W. Dewitt Vosbury. Describes work at Haddonfield, N. J., in connection with artesian water-works. Ills. 1500 w. Eng News—Aug. 25, 1910. No. 16630.

The Design of Large Steel Tanks. John E. and Wm. S. B. Irvine. Read before the Glasgow Tech. College Sci. Soc. Considers steel tanks for storing liquids, describing methods of design. 3000 w. Mech Engr—Aug. 19, 1910. No. 16697 A.

The Design of Cylindrical Reservoirs (Le Calcul des Réservoirs circulaires). Henry Lossier. Mathematical exposition of the method of calculation. Ills. 4000 w. Génie Civil—July 30, 1910. No. 16553 D.

Water Works.

Water Supply. Martin Deacon. From a paper before the Roy. Inst. of Pub. Health Cong. Discusses reservoirs, dams, embankments, filters, wells, etc. 2500 w. Surveyor—Aug. 12, 1910. No. 16495 A.

The Water-Works of Monterey, Mexico. Illustrated detailed description of recently completed works. 3000 w. Eng Rec—Aug. 6, 1910. No. 16220.

Water-Works Valuation.

The Appleton Water-Works Decision. A report of the valuation controversy in Wisconsin. 3500 w. Eng Rec—Aug. 6, 1910. No. 16218.

Wharves.

Wharf Construction at Fort Mason, California. Illustrated detailed description of the construction methods used in building wharves for the quartermaster's department of the U. S. Army on San Francisco Bay. 4000 w. Eng Rec—Aug. 6, 1910. No. 16214.

WATERWAYS AND HARBORS.

Barge Canal.

See also Locks, under WATERWAYS AND HARBORS.

Canal Gates.

Emergency Gates on the Illinois and Mississippi Canal. Describes these gates and their operation. 2000 w. Eng Rec—Aug. 20, 1910. No. 16443.

Canals.

The Tieton Canal. E. G. Hopson. Describes the main canal or aqueduct along the Tieton Canon, in the State of Washington, several novel features of design and construction having been adopted. Ills. 9500 w. Pro Am Soc of Civ Engrs —Aug., 1910. No. 16640 F.

Project for a Ship Canal Between the Tyne and Solway Firth. J. Watt Sandeman. Briefly reviews various schemes considered and describes in detail the project named, discussing its advantages. 4500 w. Trans N-E Coast Inst of Engrs & Shipbldrs—July, 1910. No. 16392 N.

The Manchester Ship Canal. H. G. Moulton. Extracts from the *Jour. of Political Economy*. Reviews briefly the story of its construction, and discusses its economic aspects. 5000 w. Ry & Engng Rev —Aug. 13, 1910. No. 16372.

Constantza.

The Harbor of Constantza. Dr. Alfred Gradenwitz. Illustrated description of an artificial harbor basin constructed in Roumania. 3500 w. Sci Am Sup—Aug. 20, 1910. No. 16432.

Dikes.

Dike at Herring River, Wellfleet, Mass. Mosquito Extermination Work. Frank W. Hodgdon. Illustrated detailed description of a dike built on Cape Cod to abolish mosquitoes by drainage of the marshes, and also reclaiming a large area of fertile land. 1200 w. Eng News—Aug. 11, 1910. No. 16315.

Floods.

Report of the Flood on the Zuni River, Sept. 6, 1909. H. F. Robinson. An account of the flood in New Mexico which caused the failure of the Zuni dam. 1200 w. Eng News—Aug. 25, 1910. No. 16629.

Germany.

The Opening of the Bodensee and the Making of the Upper Rhine Navigable Between Constance and Basel (De Ontsluiting van de Bodensee en het Bevaarbaar Maken van den Boven-Rijn tusschen Konstanz en Basel). R. P. J. Tutein Nolthenius. A technical and economic discussion. Ills. 6000 w. De Ingenieur —July 23, 1910. No. 16796 D.

Great Britain.

The Harbors of Great Britain, with Some Reference to Those of North Europe and North America. J. V. Nimmo. A memorandum prepared for the Sociological Soc. of Gt. Britain. 5500 w. Eng News—Aug. 11, 1910. No. 16310.

Locks.

The Siphon Lock at Oswego. Illustrated detailed description. 2500 w. Barge Canal Bul—July, 1910. No. 16272 N.

The Siphon Lock on the Barge Canal at Oswego. Illustrates and describes the first siphon lock to be built in the United States, and said to be the largest ever constructed on the siphon principle. 2000 w. Eng Rec—July 30, 1910. No. 16059.

Panama Canal.

Machinery and Equipment on the Panama Canal Works. This first article illustrates and describes steam shovels, drills, and air compressors. 2500 w. Engr, Lond—Aug. 12, 1910. Serial. 1st part. No. 16603 A.

River Regulation.

Prejudicial Effects of River Regulation in Inhabited Regions (Su certi dannosi Effetti che puo Produrre la Sistemazione dei Fiumi Attraverso gli Abitati). P. Alibrandi. Discusses the possible effect of changing the subterranean water level, with special reference to the Tibur. 3600 w. Ann d Soc d Ing e d Arch Ital—June 15, 1910. No. 16559 F.

Stream Regimen and Dam Construction in the Eastern Alps (Flussregime und Talsperrenbau in den Ostalpen). Discussion of M. Singer's paper printed in this journal for Dec. 10, 1909 et seq. Serial. 1st part. 8000 w. Zeitshcr d Oest Ing u Arch Ver—July 1, 1910. No. 16756 D.

The Navigable Rivers of Krain and Their Regulation (Die schiffbaren Flüsse in Krain und ihre Regulierung). Karl Pick. Discusses the possibility of improving the navigable waterways of this part of Austria. Ills. Serial. 1st part. 4000 w. Oest Wochenschr f d Oeffent Baudienst—July 16, 1910. No. 16758 D.

Sea Walls.

Reinforced Concrete Sea Wall Construction of Separately Molded Members. From information furnished by W. E. Adams, London. Describes the new trestle wall system being carried out at Miller's Point. Ills. 3000 w. Engng-Con—Aug. 24, 1910. No. 16619.

Water Powers.

Conservation of Water Powers. Lewis B. Stillwell. Presidential address discussing the practical bearing and effect of existing laws governing the appropriation of water powers located on public lands. 6000 w. Pro Am Inst of Elec Engrs—Aug., 1910. No. 16398 F.

ELECTRICAL ENGINEERING.

COMMUNICATION.

Radiotelegraphy.

New Form of Aerials for Wireless Telegraphy. F. Kiebitz, in *Ann. der Physik.* Considers the influence of the form and disposition of the aerial upon sending and receiving distance. 1200 w. Sci Am Sup—Aug. 27, 1910. No. 16658.

Use of Hot-Wire Ammeters in the Aerial of Wireless Telegraph Stations. John S. Stone. Explains the interpretation of its readings. 600 w. Elec Rev, N Y—Aug. 20, 1910. No. 16459.

See also Thermo-Junctions, under MEASUREMENT.

Telegraph Instruments.

Telegraph Instruments for Rapid Working (Les Appareils Telégraphiques rapides). M. Devaux-Charbonnel. Describes the Pollac-Virag, Baudot, and other apparatus. Ills. 5500 w. Tech Mod (Sup.)—July, 1910. No. 16526 D.

Telegraph Lines.

The Influence of High-Tension Currents on Telegraph and Telephone Installations. Abstract translation from *L'Indus. Elec.* Brief account of remedies adopted to do away with the troubles, giving a summary of new rules of the Prussian State R. R. Dept. on the building of high-tension lines. 1200 w. Elec Rev, N Y—July 30, 1910. No. 16087.

Telegraph Printers.

A Hughes Printing Telegraph of Large

Capacity (Appareil Hughes à grand Rendement). J. Pierart. Describes a Belgian modification of the Hughes system exhibited at Brussels. Ills. 2700 w. Soc Belge d'Elecns—June, 1910. No. 16502 E.

Telegraphy.

Telegraph Systems: 1907. A compilation of statistics and general information concerning the telegraph industry. Ills. 22500 w. Bureau of the Census—Bul. 102. No. 16156 N.

Telephone Exchanges.

New Post Office Telephone Exchange at Glasgow. Illustrated detailed description. 700 w. Elect'n, Lond—Aug. 19, 1910. Serial. 1st part. No. 16707 A.

Telephone Lines.

See Telegraph Lines, under COMMUNICATION.

Telephony.

Some Notes on a Trip to the North American Continent. W. A. J. O'Meara. An account of telegraph and telephone installations visited in the United States, comparing with English practice. 2000 w. Elect'n, Lond—July 22, 1910. No. 16131 A.

Telephotography.

The Telegraphy of Photographs, Wireless and by Wire. T. Thorne Baker. Discourse at the Roy. Inst. Describes systems used, the apparatus and methods. Ills. 6500 w. Nature—Aug. 18, 1910. No. 16691 A.

DYNAMOS AND MOTORS.

A. C. Dynamos.

Paralleling Alternators. Diagrams and explanation of the precise method of procedure. 2500 w. Engr, Lond—Aug. 5, 1910. Serial. 1st part. No. 16360 A.

Recent Arrangements for the Parallel Running of Electric Machines. W. Wolf. Abstracted from *Elektrotechnik und Maschinenbau.* Deals with the methods employed by the leading firms on the Continent, both for the parallel running and synchronizing of electric machines. Diagrams. 2200 w. Elect'n, Lond—July 29, 1910. No. 16236 A.

A. C. Motors.

The Cascade Motor. Mr. Williams-Ellis. Read before the Assn. of Min. Elec. Engrs., at Nottingham. Illustrated description, explaining the principle and development of this machine. 5500 w. Ir & Coal Trds Rev—Aug. 5, 1910. No. 16365 A.

Polyphase Commutator Machines. J. Jonas. Abstract from *Electrotechnische Zeit.* Discusses the necessity for and possibility of a polyphase motor with economical speed regulation. Describes the polyphase commutator motor and its applications. 2000 w. Elect'n, Lond—Aug. 12, 1910. No. 16491 A.

Constant-Speed A. C. Commutator Motors (Wechselstrom-Kommutatormotoren für praktisch konstante Tourenzahl). F. Niethammer. Brief description of a number of leading types. Ills. 1200 w. Elektrotech u Maschinenbau—July 3, 1910. No. 16773 D.

A. C. Turbogenerators.

Short-Circuit Effects and the Construction of Turbogenerators (Kurzschlusswirkungen und Aufbau von Turbogeneratoren). F. Niethammer. An extension of the author's paper in *Elektrische Kraftbetriebe und Bahnen* for December 14, 1910. Ills. Serial. 1st part. 3500 w. Elek Kraft u Bahnen—July 4, 1910. No. 16767 D.

Armatures.

Faulty Armatures. W. H. F. Murdoch. Explains how to locate the faults and their causes. 700 w. Elec Rev, Lond—July 29, 1910. No. 16233 A.

Commutation.

Commutation Phenomena and Magnetic Oscillations Occurring in Direct-Current Machines. G. W. Worrall. Abstract of paper and discussion before the Birmingham Sec. of the Inst. of Elec. Engrs. describing experimental investigations. 8500 w. Elec Rev, Lond—July 29. 1910. No. 16234 A.

D. C. Motors.

Shunt Regulating Resistances for Shunt-Wound Motors (Ueber Nebenschluss-Regulier-Widerstände für Nebenschluss-Motore). Carl Gruber. Mathematical. Ills. Serial. 1st part. 1200 w. Elektrotech Rundschau—July 7, 1910. No. 16765 D.

Foundations.

Foundations for Electrical Machinery. Bruce Page. Discusses the requirements of such foundations. Ills. 1500 w. Elec Wld—Aug. 4, 1910. No. 16190.

Friction Losses.

Friction Losses of a Dynamo. A discussion of brush and journal friction, with curves giving the friction loss in each case. 2000 w. Power—Aug. 2, 1910. No. 16072.

Induction Motors.

The Hopkinson Test Applied to Induction Motors. George H. Fletcher. Describes a method of testing induction motors of comparatively large sizes. 900 w. Elec Rev, Lond—Aug. 5, 1910. No. 16340 A.

Installing Induction Motors. R. H. Fenkhausen. Discusses size and arrangement of connecting wires, power factors, overload protection, protection of live parts, and location of motors. Ills. 2500 w. Power—Aug. 23, 1910. Serial. 1st part. No. 16472.

Railway Motors.

The Electric Motor with Variable Speed on the "B. V. D." System. Paul Bary. Explains the characteristics of this system, and reports experiments with a traction motor. Ills. 4500 w. Tram & Ry Wld—Aug. 4, 1910. No. 16488 B.

Rheostats.

Design of Drum Rheostats. L. W.

Rosenthal. Describes an acceptable form, giving tables of winding characteristics and wire constants. 900 w. Elec Wld—Aug. 18, 1910. No. 16423.

Windings.

Analysis of Leakage Reactance. J. Rezelman. Investigations of the leakage of the windings of a. c. machines. Mathematical. 2000 w. Elect'n, Lond—July 22, 1910. Serial. 1st part. No. 16132 A.

ELECTRO-CHEMISTRY.

Corrosion.

Corrosion of Iron Embedded in Concrete. Guy F. Shaffer. Report of recent tests carried out to obtain data on the effect of currents of low potential on imbedded steel. Ills. 1600 w. Eng Rec—July 30, 1910. No. 16063.

Some Theories and Notes on the Corrosion of Copper and Brass. W. B. Tardy. A résumé of a paper by E. L. Rhead, and the discussion thereon, before the Inst. of Metals. 2000 w. Jour Am Soc of Nav Engrs—Aug., 1910. No. 16797 H.

Electric Furnaces.

Elementary Principles of the Designing and Proportioning of Electrical Furnaces. Carl Hering. Aims to summarize the principles involved in furnace design as far as the proportions are concerned, and to describe the proper sequence in making the calculations. 3000 w. Met & Chem Engng—Aug., 1910. No. 16116 C.

Electroplating.

A Simple Method of Making a Bronze Plating Solution. Describes a solution of copper and zinc for electroplating steel and iron goods. 3000 w. Brass Wld—Aug., 1910. No. 16404.

Nitrogen.

Dr. Schönherr's Process for Producing Atmospheric Nitrates. Brief description of this method for forming nitrogenous products by the electric arc, soon to be applied on a large scale in Norway. 1500 w. Elect'n, Lond—Aug. 5, 1910. No. 16342 A.

Present Status of the Nitrogen Problem (Lo Stato attuale del Problema dell' Azoto). Mario Lombardi. A review of recent developments in the fixation of atmospheric nitrogen. 5000 w. Monit Tech—July 10, 1910. No. 16563 D.

ELECTRO-PHYSICS.

Coherers.

Coherers. W. H. Eccles. Read before the Phys. Soc. Develops a method of investigating detectors, and gives results of experiments on coherers made of oxidized iron wire dipped into mercury, and on coherers made of a clean iron point touching an oxidized iron plate. 2500 w. Elect'n; Lond—Aug. 12, 1910. Serial. 1st part. No. 16489 A.

Impedance.

An Impedance Paradox. F. M. Denton. Gives diagram and explanation. 500 w. Elec Wld—Aug. 11, 1910. No. 16308.

Magnetism.

Contact Difference of Potential in a Magnetic Field. E. P. Adams. Discusses the theory and describes experiments. 1200 w. Elect'n, Lond—Aug. 12, 1910. No. 16492 A.

GENERATING STATIONS.

Accumulators.

Storage Batteries in Isolated Plants. Norman G. Meade. How to find the size of battery required, and discussing rheostat and end-cell regulations. Ills. 2000 w. Power—Aug. 9, 1910. No. 16262.

Storage Batteries in Central Stations. R. Werkner. Discusses the relation of storage batteries to the different systems of generation and distribution. 2200 w. Elec Engr, Lond—Aug. 19, 1910. No. 16702 A.

Installation of Large Battery and Boosters at Dickinson Street Electricity Works, Manchester. S. L. Pearce. Illustrates and describes the general details of the large Tudor battery and automatic reversible boosters. 1500 w. Elec Rev, Lond—July 22, 1910. No. 16126 A.

The Génard "Phœnix" Accumulator (L'Accumulateur "Phœnix," Système F. A. Génard). J. A. Montpellier. Illustrated description. 1800 w. L'Elecn—July 2, 1910. No. 16537 D.

Determination of the Size and Effect of Buffer Batteries (Zur Vorausbestimmung der Grösse und Wirkung von Pufferbatterien). K. Zickler. Describes a method of predetermining the proper size and action of a battery to operate in parallel with a generator. Ills. 4500 w. Elektrotech u Maschinenbau—July 10, 1910. No. 16774 D.

See also Electric, under MECHANICAL ENGINEERING, AUTOMOBILES.

Austria.

Statistics of Central Stations in Austria (Statistik der Elektrizitätswerke in Oesterreich). A brief summary with a supplement giving details of the 675 in Austria on July 1, 1910. 14000 w. Elektrotech u Machinenbau—July 31, 1910. No. 16778 F.

Central Stations.

New Power Stations at Scranton, Penn. F. W. Brady and C. J. Mason. Illustrated description of a 1000 k. w. plant supplying d. c. for street railway service. Uses culm for fuel. 2000 w. Power—Aug. 30, 1910. No. 16732.

Electric Plant at Messina, Italy. Illustrated description of the station which survived the earthquake of 1908, the effect of the earthquake and repairs. 1500 w. Elec Wld—Aug. 11, 1910. No. 16306.

The Extension of the Värta Steam Station of the Stockholm Electrical System in 1909 (Die Erweiterung des Värta-Dampfkraftwerkes der Elektrizitätswerke der Stadt Stockholm im Jahre 1909). E. Andreason. Describes the new equipment. Ills. 2000 w. Elek Kraft u Bahnen—July 24, 1910. No. 16771 D.

Economics.

Diversity Factor. H. B. Gear. Analytical study, with deductions. 3000 w. Pro Am Inst of Elec Engrs—Aug., 1910. No. 16400 F.

Motors on Hire. E. P. Austin. Explains this scheme for developing a power load. 2000 w. Elec Rev, Lond—Aug. 19, 1910. No. 16705 A.

Hydro-Electric.

A General Review of Hydro-electric Engineering Practice. Frank Koester. Sixth and concluding article of a series, discussing the financial aspects of power enterprises. Ills. 3000 w. Engineering Magazine—Sept., 1910. No. 16739 B.

The Boulder Hydroelectric Plant. Illustrates and describes the hydraulic work in connection with the plant at Boulder, Colo. 2800 w. Eng Rec—July 30, 1910. No. 16055.

The Arizona Power Company. R. S. Masson. Illustrated description of hydro-electric development, including novel intake, concrete flume, tunnels, syphons and concrete pipe line. Editorial note. 4400 w. Elec Wld—Aug. 18, 1910. No. 16422.

Hydro-Electric Development of the Arizona Power Company R. S. Masson. Illustrated description of a development obtaining the supply of water from Fossil Springs. 4000 w. Eng Rec—Aug. 20, 1910. No. 16444.

A Michigan Hydroelectric Development. Brief illustrated description of a water power plant of unusual design for Sturgis, Mich. 600 w. Elec Wld—Aug. 25, 1910. No. 16617.

The Wood Pulp and Paper Mills of the Anglo-Newfoundland Development Co. Illustrated description of a large hydro-electric scheme, with the object of providing cheaper paper for London newspapers. 2000 w. Elect'n, Lond—July 29, 1910. Serial. 1st part. No. 16238 A.

Electric Power in and Around Cobalt. Describes the Nipissing Central Railway, the hydroelectric development of the Cobalt Hydraulic Company, an hydraulic compound air plant, and the hydroelectric development of the Cobalt Power Company. Ills. 2500 w. Can Elec News—Sept., 1910. Serial. 1st part. No. 16690 C.

The Kinlochleven Hydroelectric Power Plant. Illustrated description of a modern works in Scotland for the manufacture of aluminum. 2000 w. Elec Rev, N Y—Aug. 27, 1910. No. 16678.

Hydroelectric Development of the Michoacan Power Company. Irwin C. McBride. Illustrated detailed description of power development in Mexico, on the Rio Angulo. 2200 w. Eng Rec—Aug. 27, 1910. No. 16662.

The Rio de Janeiro Electrical Installations (Les Installations électriques de Rio-de-Janeiro). M. Mangin. Describes the generating station and transmission system. Ills. 11500 w. Bul Soc Int d Elecns—July, 1910. No. 16512 F.

The Hydroelectric Plant on the Jhelum River, Kaschmir, British East Indies (Die Wasserkraftanlage am Jhelumfluss in Kaschmir, Britisch Ostindien). Heinrich Homberger. Illustrated detailed description. Serial. 1st part. 1200 w. Zeitschr f d Gesamte Turbinenwesen. July 20, 1910. No. 16750 D.

Water-Power Development on the Drance, at Martigny (Les Forces motrices de la Drance à Martigny). H. Chenaud. Describes a hydro-electric plant on this tributary of the Rhone. Ills. Serial. 1st part. 1500 w. Bul Tech d l Suisse Romande—July 25, 1910. No. 16535 D.

The International Walchensee Competition (Der internationale Walchensee-Wettbewerb). Theodor Koehn. A discussion of the designs submitted for utilizing the waters of the Welchensee for hydro-electric development. Ills. Serial. 1st part. 7000 w. Zeitschr d Ver Deutscher Ing—July 2, 1910. No. 16779 D.

The Economic Utilization of the Water Powers of Baden (Die wirtschaftliche Bedeutung der Wasserkräfte des Badischen Landes). J. Kollmann. Discusses existing developments and future possibilities in this German province. Ills. 7500 w. Tech u Wirt—July, 1910. No. 16793 D.

The Offensee and Schwarzensee Hydro-Electric Plants (Die Elektrizitätswerke Offensee und Schwarzensee). Detailed description of these two new and important Austrian plants. Ills. 6000 w. Elektrotech u Maschinenbau—July 17, 1910. No. 16777 D.

Isolated Plants.

Electrical and Mechanical Installation in the Blackstone Hotel. Illustrated description of the electrical equipment for a Chicago hotel. 3500 w. Elec Rev, N Y—Aug. 20, 1910. No. 16458.

Rates.

The Cost of Electricity. W. D. Marks. An attempt to solve the rate problem on the basis of fixed and variable charges involved in the operation of the plant. Also editorial. 5500 w. Elec Wld—Aug. 4, 1910. No. 16189.

Switchboards.

American Switchboard Practice. Stephen Q. Hayes. Considers the influence of distant-control switchgear on alternating-current station design. Ills. 3000 w. Elec Wld—Aug. 4, 1910. Serial. 1st part. No. 16188.

LIGHTING.

Incandescent Lamps.

Tungsten Lamp Manufacturing. Newton Harrison. An explanation of the fragility of the tungsten filament and suggestions for the making of an ideal tungsten lamp. 2500 w. Cent Sta—Aug., 1910. No. 16263.

An Improved Method of Sorting Incandescent Lamps. K. Keil. Abstract translation from *Elektrotechnische Zeit.* Gives a graphical solution. 900 w. Elect'n, Lond—July 22, 1910. No. 16129 A.

The Development of the One-Watt-per-Candle Metallic-Filament Lamp in the last two years (Die Entwicklung der Einwatt-Metallfadenlampe in den letzten zwei Jahren). Hartwig v Löti. A review of advances in processes of manufacture. Ills. 3000 w. Elektrotech u Maschinenbau—July 10, 1910. No. 16775 D.

Photometry.

A Portable Phosphorescent Photometer. W. T. Vivian and George W. Huey. An experimental study made at the University of Nebraska aiming to utilize phosphorescent substances as photometric standards of comparison. Editorial note. Ills. 2500 w. Elec Wld—Aug. 18, 1910. No. 16425.

The Hartmann and Braun Portable Apparatus for Testing Incandescent Lamps (Appareil transportable universel pour Mesure des Constantes des Lamps à Incandescence, Système Hartmann et Braun). M. Aliamet. Describes a device combining a photometer, an ammeter, and a voltmeter. Ills. 1500 w. L'Elecn—July 2, 1910. No. 16538 D.

Street.

The Tungsten Lamp as a Factor in Modern Street Lighting. An illustrated discussion showing that the tungsten lamp, with proper auxiliary fixtures, has made it possible to greatly improve street lighting. 2500 w. Elec Jour—Aug., 1910. No. 16383.

MEASUREMENT.

Dynamo Testing.

Retardation Tests of Electrical Machines. F. W. Herlan. Mathematical. 2200 w. Elec Rev, N Y—Aug. 27, 1910. No. 16679.

Electrometers.

The Elementary Theory of the Quadrant Electrometer. R. Beattie. Gives a simple proof of the theory and discusses its sensibility characteristics, and compares them with those of an alternate current moving coil galvanometer. 3000 w. Elect'n, Lond—Aug. 12, 1910. No. 16490 A.

Frequency.

Frequency Meters (Die elektrischen Frequenzmesser). O. Marteinssen. Describes various types. Ills. 2000 w. Elek Kraft u Bahnen—July 11, 1910. No. 16768 D.

Hysteresis.

The Mechanical Measurement of the Work of Hysteresis of Iron in a Rotating Field. G. Vallauri. Reviews the work of other investigators and gives the author's results. 1600 w. Elect'n, Lond—July 22, 1910. No. 16130 A.

Instrument Transformers.

Some Notes on the Use of Instrument Transformers. Kenelm Edgecombe. Discusses errors likely to be introduced by their use, and concludes that with satisfactory design and reasonable precautions the errors are so small as to be negligible in practice. 2300 w. Elec Rev, Lond—July 29, 1910. No. 16232 A.

Laboratory.

Experimental Electrical Circuits for Laboratories. W. P. Steinthal. Read before the Inst. of Elec. Engrs. Illustrated description of recent arrangements for laboratory work in England. 6000 w. Elec Engr, Lond—July 22, 1910. No. 16125 A.

The Work of the Physikalisch-Technische Reichsanstalt in 1909. Details of the electrical work done in the past year. 2500 w. Elect'n, Lond—July 29, 1910. Serial. 1st part. No. 16237 A.

Thermo-Junctions.

On the use of Thermo-Junctions for High-Frequency Current Measurements. C. M. Dowse. Describes a form of thermo-junction suitable for radio-telegraphic measurements in technical colleges. Tests are given showing such junctions are reasonably permanent. 3500 w. Elect'n, Lond—Aug. 19, 1910. No. 16706 A.

Transformer Testing.

The Testing of Transformer Regulation. C. V. Drysdale. Proposes a method in which the voltage of the transformer under test is compared with that of a second transformer of approximately the same ratio on open circuit. 2000 w. Elect'n, Lond—July 29, 1910. No. 16239 A.

POWER APPLICATIONS.

Dock Equipment.

The Electrical Equipment of Smiths Docks, Middlesbrough. Illustrates and describes applications of electricity for power and lighting. 1500 w. Elec Rev, Lond—Aug. 5, 1910. No. 16339 A.

TRANSMISSION.

Cables.

Constants of Cables. Mayo Dyer Hersey. Deduces simple expressions for the resistance, inductance and capacity of eccentric cylinders. 900 w. Elec Wld—Aug. 25, 1910. No. 16618.

Bonding Lead-Covered Cables to Prevent Electrolysis. W. G. Middleton. Discusses good and bad practice, and related subjects. Ills. 4000 w. Elec Rev, N Y—Aug. 27, 1910. No. 16680.

Lightning.

Causes of Lightning. Extract from a

paper by Dr. J. C. Simpson on experiments on atmospheric electricity. 1500 w. Elec Engr, Lond—Aug. 19, 1910. No. 16703 A.

Line Construction.

Network Conductors (Netzleiter). F. Schauer. Describes details of construction for transmission-line railway crossings. Ills. 2000 w. Elek Kraft u Bahnen—July 14, 1910. No. 16770 D.

Line Design.

Problems in Power Transmission. H. W. Buck. Discusses the advantage of steel towers, length of span, suspension insulators, anchoring the conductors, practical limit of pressure, voltage regulation, etc. 2500 w. Elect'n, Lond—Aug. 19, 1910. No. 16708 A.

Copper Economics in Electrical Distribution. W. H. Myers. Discusses the relative values of different methods of distribution as regards the total weight of conductor and the factors determining the size used. 2500 w. Aust Min Stand—June 15, 1910. Serial. 1st part. No. 16117 B.

Lines.

Electricity for Factories at Kokomo, Ind. Illustrated description of the electrical distribution system of a company which supplies energy for traction, light and power purposes. 2500 w. Elec Wld—Aug. 4, 1910. No. 16187.

See also Hydro-Electric, under GENERATING STATIONS.

Poles.

The Design of Poles (Berechnung von Ueberführungsmasten). Otto Rieger. Describes a method of calculating the necessary size of transmission-line poles of either wood or iron and also the depth to which they must be buried. Ills. 3000 w. Elektrotech u Maschinenbau—July 17, 1910. No. 16776 D.

Regulations.

The French Laws Governing the Distribution of Electricity (Apropos des Règlements administratifs concernant les Distributions d'Energie électrique). M. Brunswick. A report of a committee appointed to consider certain features of the regulations. Ills. 26000 w. Bul Soc Int d Elecns—July, 1910. No. 16511 F.

Transformers.

Transformer Characteristics. K. Faye-Hensen. Describes test methods used to determine the voltage drop of transformers having poor regulation. The results show a considerable change in the local magnetic leakage impedance of certain transformers. Editorial note. 2500 w. Elec Wld—Aug. 18, 1910. No. 16424.

Some Interesting Features in the Design and Application of Transformers. E. G. Reed. Discusses transformer types, showing that large low-voltage units should be built shell type and small high-voltage transformers core type; each class having its own field. 2500 w. Elec Jour—Aug., 1910. No. 16386.

Recent Improvements in Distributing Transformers and Their Relation to Methods of Distribution. J. Frank Martin. Claims that their use as outlined will reduce the investment and increase the efficiency. 1600 w. Elec Rev. N Y—Aug. 6, 1910. No. 16207.

The Stigler-de Faria Static Converters (Convertisseurs statiques, Système Stigler-de Faria). M. de Kermond. Detailed description. Ills. 2000 w. L'Elecn—July 23, 1910. No. 16541 D.

MISCELLANY.

Accidents.

Accidents Due to Excess Voltages and Short Circuits in Electrical Plants and Transmission Lines (Premiers Resultats de l'Enquête sur les Accidents dus aux Surtensions et aux Courts-Circuits dans les Usines et les Reseaux). M. Legouez. First report of a committee investigating electrical accidents. Ills. 7000 w. Bul Soc Int d Elecns—July, 1910. No. 16513 F.

Agriculture.

Electricity in Agriculture (La Force motrice électrique en Agriculture). M. Henry. Abstracted from publications of the A. E. G. 1800 w. L'Elecn—July 2, 1910. No. 16539 D.

Electric Clocks.

Electric Clocks. Illustrates and describes a balance wheel electric clock, and a pendulum electric clock invented by Mr. Murday. 1600 w. Sci Am—Aug. 20, 1910. No. 16431.

INDUSTRIAL ECONOMY.

Accountants' Organization.

Organization—Its Objects and Their Attainment. George Edwards. Discusses the usefulness of organization to accountants in Canada. 4000 w. Jour of Acc—Aug., 1910. No. 16380 C.

Apprenticeship.

Apprenticeship and Industrial Education (L'Apprentissage et l'Enseignement professionnel). Maurice Bellom. A discussion of industrial conditions in France. 4300 w. Génie Civil—July 9, 1910. No. 16547 D.

British East Africa.

Notes on Engineering Matters in British East Africa. E. Keith Abbott. An account of difficulties encountered and overcome in a new country. 2200 w. Jour S African Assn of Engrs—July, 1910. No. 16661 F.

Education.

Study of Materials as a Subject in a Course in Chemical Engineering. Abstract of the presidential address of Dr. Charles F. McKenna, delivered at the Niagara Falls meeting of the Am. Inst. of Chem. Engrs. 2500 w. Met & Chem Engng—Aug., 1910. No. 16113 C.

Outline of a Course in Machine Work. E. H. Fish. Gives a table outlining operations representative of general machine work, with remarks. 1000 w. Am Mach Vol. 33, No. 32. No. 16279.

A Descriptive List of Trade and Industrial Schools in the United States. Facts relating to the organization, administration, methods of instruction and course of study. 30000 w. Nat Soc for Pro of Ind Ed—Bul. No. 11. No. 16473 N.

Education for Efficiency in Railroad Service. D. C. Buell. Read before Assn. of Ry. Tel. Supts. Describes the educational bureau of the Union Pacific R. R. Co. and its work. 5500 w. Pro St Louis Ry Club—July 8, 1910. No. 16382.

The Wigan and District Mining and Technical College. Illustrated description of the buildings and equipment. 2500 w. Col Guard—Aug. 12, 1910. No. 16498 A.

Engineering Instruction at the Imperial Pei Yang University, Tientsin, China. Walter H. Adams. Abstract of paper read before the Soc. for Pro. of Engng. Ed. Describes the work being done at the university named. 1800 w. Eng News—Aug. 11, 1910. No. 16318.

Reform in Mining Education and the Metallurgical Industry (Die Reform des montanistischen Hochschulunterrichtes und die Hüttenindustrie). R. Vambera. Discusses the neglect of metallurgical engineering education in Austria. 2000 w. Oest Zeitschr f Berg- u Hüttenwesen—July 23, 1910. No. 16587 D.

Employers' Liability.

See Labor Insurance, under INDUSTRIAL ECONOMY.

Engineering.

Engineering Professions. Benjamin B. Lawrence. Also gives views of Eugene Klapp, and of Dr. Cary T. Hutchinson. 1700 w. Sch of Mines Qr—April, 1910. No. 16474 D.

Engineering Societies.

The New Building of the Institution of Civil Engineers. Illustrations of the façade and the floor plans of this new building in London. Engineering Magazine—Sept., 1910. No. 16738 B.

Exhibitions.

Fire at the Brussels Exhibition. An illustrated account of this disaster. 1800 w. Engr, Lond—Aug. 19, 1910. No. 16720 A.

Indexing Systems.

A Method of Indexing Engineering Information. F. Lavis. Explains a method used by the writer. 2000 w. Eng Rec—Aug. 13, 1910. No. 16324.

Industrial Museums.

The Royal Bavarian Transportation Museum in Nürnberg (Das Königl. Bayerische Verkehrsmuseum in Nürnberg). E. A. Ziffer. Describes a museum devoted wholly to railway exhibits. Ills. 7000 w. Mitt d Ver f d Förd d Lokal- u Strassenbahnwesens—July, 1910. No. 16572 F.

Japan.

Japanese Industries at the Japanese-British Exhibition. Robert H. Smith. Brief descriptions of the carpentry and timber, silk, paper and printing, tea, fisheries, and mining are given in the present articles. 2500 w. Engr, Lond—July 29, 1910. Serial. 1st part. No. 16252 A.

Labor.

Labor Conditions in American and German Machine Shops and Foundries. W. H. Dooley. An interesting comparison. 2500 w. Mach, N Y—Aug., 1910. No. 16109 C.

Employers and Employees (Employeurs et Employés). Maurice Bellom. A general discussion of the labor problem, referring particularly to conditions in France. Ills. 11200 w. Tech Mod (Sup)—July, 1910. No. 16528 D.

Labor Insurance.

The New Employers' Liability Law, New York. Gives a recently passed act amending the labor law in relation to workmen's compensation in certain dangerous employments. 2500 w. Eng Rec—Aug. 27, 1910. No. 16663.

Management.

The Twelve Principles of Efficiency. Harrington Emerson. This fourth article of a series discusses the second principle: common sense. 5000 w. Engineering Magazine—Sept., 1910. No. 16740 B.

Time-Keeping and Labour Distribution in the Foundry. Victor R. Claydon. Fourth and concluding number of a serial, discussing methods of obtaining true costs of castings. 2500 w. Engineering Magazine—Sept., 1910. No. 16742 B.

Industrial Betterment. H. F. J. Porter. Discusses modern methods of administration of workshops. 6500 w. Cassier's Mag—Aug., 1910. No. 16287 B.

Patents.

The Uniform Patent Law (Disegno di Legge sulle Privative industriali). Reviews the work of previous congresses and reports the findings of the Congress held at Brussels, June 2-5, 1910. Serial. 1st part. 4500 w. Industria—July 3, 1910. No. 16567 D.

Profits.

Manufacturing Profits and Losses. Henry Hess. A study of relationship between capitalization, invested capital, labor, material, output, and size of plant. 2200 w. Engineering Magazine—Sept., 1910. No. 16745 B.

Purchasing.

The Purchasing of Material. L. S. Randolph. Briefly considers the subject under the divisions of quantity, quality and price. 1500 w. Cassier's Mag—Aug., 1910. No. 16290 B.

Specifications.

Government Specifications. An Example of Neglect of Three Efficiency Principles. F. Percival. Points out the inefficiency from non-observance of common sense, fair deal, and expert advice. 2000 w. Engineering Magazine—Sept., 1910. No. 16741 B.

Tariffs.

The Proposed Japanese Tariff and Its Effect on British Trade. A report summarizing the character and purpose of the new tariff, tabulating the old rates and the new, indicating the course of British trade with Japan in recent cases and the comparative growth of British, German and United States trade, and giving an analysis of British imports from Japan. 11000 w. British Tariff Commission—July, 1910. No. 16257 N.

Time-Keeping.

Time Computing Devices (Arbeitzeit-Zähler). Jul. H. West. Describes devices manufactured by C. & E. Fein, Stuttgart. Ills. 2500 w. Tech u Wirt—July, 1910. No. 16794 D.

MARINE AND NAVAL ENGINEERING.

Battleships.

Comparison of the Argentine Battleship "Rivadavia" with the "Wyoming." Illustrations and comparison of the Argentine, and the United States battleships now under construction in the United States. 2000 w. Sci Am—Aug. 27, 1910. No. 16657.

Coal Consumption.

A Method of Estimating the Coal Consumption of Vessels at Various Speeds. Ormond L. Cox. Aims to show that an equation may be deduced that will contain all possible powers of the speed. Curves. Short discussion. 2500 w. Jour Am Soc of Nav Engrs—Aug., 1910. No. 16749 H.

Colliers.

Design for a Naval Collier. R. E. Barry. Illustrated description of a vessel designed to meet stated conditions. 1200 w. Int Marine Engng—Aug., 1910. No. 16200 C.

Cruisers.

Comparative Trials of Scout Cruisers Birmingham, Salem, Chester. W. W. White. Report of an extensive series of tests carried out with a view to comparing steam expenditures of reciprocating and turbine propelling machinery. Ills. and charts. 25000 w. Jour Am Soc of Nav Engrs—Aug., 1910. No. 16748 H.

H. M. Protected Cruiser "Newcastle." Illustrated description of this vessel, a type of the light unarmored ships intended for reconnaissance work. 1500 w. Plates. Engng—Aug. 19, 1910. No. 16714 A.

Italian Armored Cruiser S. Giorgio. Dagnino Attilio. Illustrated description of the third of four cruisers building for the Italian navy. 800 w. Int Marine Engng—Aug., 1910. No. 16198 C.

Destroyers.

Modern Torpedo Boat Destroyers. Considers present tendencies, and the features characterizing the new type of destroyers. 3500 w. Int Marine Engng—Aug., 1910. No. 16201 C.

Description and Trials of U. S. Torpedo-Boat Destroyers Smith and Lamson. W. B. Robins. Ills. 10800 w. Jour Am Soc of Nav Engrs—Aug., 1910. No. 16798 H.

U. S. S. Preston. William Ashby Leavitt, Jr. Illustrations, descriptions and report of official tests. 6000 w. Jour Am Soc of Nav Engrs—Aug., 1910. No. 16800 H.

Brazilian Torpedo Boat-Destroyers. Information concerning the ten vessels, all of one design, built in England for the Brazilian Government. 1000 w. Engng—Aug. 19, 1910. No. 16715 A.

Dredges.

The Fruhling Suction Dredge. John Reid. A discussion of the suction hopper dredge and illustrated detailed description of the improved dredge invented by Otto Fruhling and its history. Discussion. 6500 w. Pro Engrs' Club of Phila—July, 1910. No. 16395 D.

Electric Power.

The Electric Propulsion of Ships. Atholl Blair and J. F. Wilson. Gives particulars of equipment suggested for the cross-channel vessel, "Londonderry." 2500 w. Elect'n, Lond—Aug. 19, 1910. No. 16709 A.

Hydroplanes.

The Possibilities of the Hydroplane. Discusses the hydroplane boat, "Miranda IV," showing the principles on which she is constructed. 1700 w. Engng—Aug. 5, 1910. No. 16353 A.

A Hydroplane with Both Sub-Surface and Gliding Planes (Hydroplane mit unterwasser-Flächen und Gleitflächen). Fr. Wm. Seekatz. Describes a novel hydroplane designed by Henri Fabre. Ills. 1800 w. Motorwagen—July 31, 1910. No. 16772 D.

Internal-Combustion Motors.

Internal Combustion Engines for Navy Launches. W. G. Diman. Report of tests at the U. S. Navy Yard, Norfolk, Va., to settle upon suitable types for use in the navy service, with conclusions. Also Lloyd's rules for internal-combustion engines. 7000 w. Jour Am Soc of Nav Engrs—Aug., 1910. No. 16799 H.

Oil Fuel.

See Steam Boilers, under MARINE AND NAVAL ENGINEERING.

Propellers.

Screw Propellers. C. W. Dyson. Gives method of designing screw propellers, based on Froude's theory as applied by Barnaby and on actual trials of vessels over a measured mile course. Charts. 5000 w. Jour Am Soc of Nav Engrs—Aug., 1910. No. 16747 H.

Comparative Propeller Tests (Vergleichsversuche mit Schiffschrauben). A. Pröll. Results of tests designed to determine the comparative efficiency of the Lorenz propeller. Ills. 5500 w. Zeitschr d Ver Deutscher Ing—July 16, 1910. No. 16785 D.

Salvage.

A Proposed Method for Raising the "Maine" from Havana Harbor. Illustrated explanation of the raising operation proposed by John F. O'Rourke. 2000 w. Eng News—Aug. 4, 1910. No. 16173.

Raising the "Maine." Illustration and brief description of the plan proposed by John F. O'Rourke. 1000 w. Sci Am—Aug. 20, 1910. No. 16430.

Floating and Repairing the Nero. Abstract from *Reactions,* illustrating and describing the salvage and repair of this U. S. collier, which was stranded on rocks near Newport, R. I. The compressed-air method was used. 1200 w. Compressed Air—Aug., 1910. No. 16402.

Shipbuilding.

The Vulcan Company's New Yard at Hamburg. Illustrated detailed description of a new shipyard on the Elbe, for repairs on warships. Plate. 5000 w. Engng—July 29, 1910. Serial. 1st part. No. 16251 A.

Ship Design.

Evolution in Naval Construction (L'Evolution dans les Systèmes de Constructions navales). M. G. Hart. Discusses recent proposals for altering the disposition of the framework of ships. Ills. 10000 w. Mem Soc Ing Civ de France—May, 1910. No. 16503 G.

Ship Inspection.

Shipping and the Protection of Public Safety (La Nave e la Tutela della pubblica Incolumita). Guilio Ingianni. A review of the practice of various countries in the inspection and registration of shipping. 15500 w. Riv Marit—July-Aug., 1910. No. 16556 E + F.

Steam Boilers.

Oil Fuel Installation on Steamships Yale and Harvard. Illustrates and describes the arrangement of piping, burners and superheating on boilers, etc. 1200 w. Int Marine Engng—Aug., 1910. No. 16199 C.

The Question of Boilers for Warships (La Question des Chaudières dans la Marine de Guerre). Discusses the diversity of types in use and their characteristics. 5600 w. Tech Mod—July, 1910. No. 16530 D.

See also Boiler Explosions, under MECHANICAL ENGINEERING, STEAM ENGINEERING.

Steamships.

The Cunard Steamship Franconia. Illustrated description of an interesting vessel of the intermediate class for the Boston service. 2500 w. Engr, Lond—Aug. 5, 1910. No. 16358 A.

Steam Turbines.

The Steam Turbine in the German Navy. Fr. Bock. Brief illustrated account of the application of the steam turbine to cruisers and torpedo boats. 700 w. Cassier's Mag—Aug., 1910. No. 16289 B.

Notes on the Operation and Management of the Curtis Turbines on the U. S. S. Salem. W. W. Smith. A brief guide, to their care, operation and management. Ills. 8500 w. Jour Am Soc of Nav Engrs—Aug., 1910. No. 16801 H.

MECHANICAL ENGINEERING.

AUTOMOBILES.

Agricultural.

See also Tractors, under AUTOMOBILES.

Alldays.

The 14-18 H. P. Alldays Car. Illustrated description of an English built car having forced lubrication. 1000 w. Autocar—Aug. 20, 1910. No. 16692 A.

Bedford.

The Bedford "Fifteen-Eighteen." Illustrated description of the construction of the chassis. 1200 w. Auto Jour—Aug. 20, 1910. No. 16693 A.

Cab.

Accounting Methods for the Taxicab Business. H. H. Wesener. Gives forms, blanks and methods of keeping all necessary records. 2500 w. Horseless Age—Aug. 3, 1910. No. 16184.

Some Comment on Taxicab Maintenance. John Squires. A discussion from the manufacturers' standpoint of the causes of excessive maintenance expense and the remedies. 3000 w. Horseless Age—Aug. 17, 1910. No. 16452.

Influence of Standardization on Taxicab Operation. Richard W. Meade. Considers its effect on earnings, expenses, etc. 1500 w. Horseless Age—July 27, 1910. No. 16054.

New York's Taxicab Industry. An illustrated account of the business and methods. 2500 w. Horseless Age—July 27, 1910. No. 16046.

Taxicab Situation in Chicago. Illustrated report of the condition and methods. 2500 w. Horseless Age—July 27, 1910. No. 16047.

Taxicab Services in Boston. Illustrated account of the conditions and service. 1500 w. Horseless Age—July 27, 1910. No. 16048.

Taxicabs in Philadelphia. Brief account of the service. Ills. 1000 w. Horseless Age—July 27, 1910. No. 16049.

Los Angeles Taxicab Situation. Summary of the companies operating and report of the service. 1200 w. Horseless Age—July 27, 1910. No. 16050.

Taxicab Progress in Great Britain. Roy Lindsay. An account of the astonishing increase during the past year, due principally to the low fares. 1500 w. Horseless Age—July 27, 1910. No. 16051.

Motor Cabs in Berlin. Dr. Ernest Valentin. Illustrates and describes the cabs now used, and gives prescribed regulations. 1200 w. Horseless Age—July 27, 1910. No. 16052.

Carbureters.

New Carbureter Principle. Illustrates a new idea involving the use of a differential compensating valve, automatic in its action without interfering with hand-control. 4000 w. Automobile—Aug. 25, 1910. No. 16652.

The Vortex Vaporizer. Describes a new idea in carbureter designing; fuel is heated to overcome the latent heat of evaporation. Ills. 5000 w. Automoible—Aug. 25, 1910. No. 16651.

Carburation Extraordinary. An account of the practical achievements of the "Polyrhoe" carburettor. Ills. 3000 w. Auto Jour—Aug. 13, 1910. No. 16482 A.

Commercial Vehicles.

The Clark Power Wagon. Illustrated detailed description. 2500 w. Automobile—Aug. 11, 1910. No. 16305.

Motor Trucks for Railroad Service. Extracts from a paper read at the S. A. E. convention by T. V. Buckwalter. Discusses their use for transfer of freight and baggage, and for other purposes. Ills. 2200 w. Automobile—Aug. 4, 1910. No. 16178.

Construction.

Use of Pressed Steel in Motor Cars. John Coapman. Remarks on the use of forgings and sheet steel stampings in place of castings. Ills. 1000 w. Am Mach—Vol. 33. No. 34. No. 16612.

Crank Motions.

The "Kilby" Crank-Motion for Petrol Engines. Illustrated description of a new device embodied in the Kilby system. The novel feature lies in the construction of the crank-shaft and of the big end of the connecting-rod. 1700 w. Auto Jour—Aug. 6, 1910. No. 16337 A.

Design.

European Tendencies in Design. Louis Ruthenburg. Discusses features of motor cars being adopted by European engineers and their probable application in the United States. 1500 w. Horseless Age—Aug. 17, 1910. No. 16454.

Electric.

Electric Automobiles in the United States Government Service. Waldon Fawcett. Descriptions and illustrations of some machines made for special services. 2000 w. Elec Rev, N Y—Aug. 13, 1910. No. 16335.

Electric Automobiles (Les Automobiles électriques). J. A. Montpellier. Describes the application of the Génard "Phoenix" accumulator in electric vehicles. Ills. 2500 w. L'Elecn—July 30, 1910. No. 16542 D.

Electric Batteries.

The Charging of Ignition Batteries (Selbstaufladen von Zündbatterien). K. Stauffer. Describes methods by which the owner of a car can do his own charging. Ills. 3000 w. Zeitschr d mit Motorwagen Ver—July 31, 1910. No. 16753 D.

Fire Apparatus.

Developments in Self-Propelled Fire Apparatus. Illustrates and describes recent gas motor fire engines equipped with power driven centrifugal and reciprocating water pumps. Also types of auto chemical engines and hose wagons. 2000 w. Com Veh—Aug., 1910. No. 16076 C.

Glasgow's Motor Fire Engines. Illustrates and describes two petrol motor fire engines of the centrifugal or turbine-pump type. 1000 w. Engr, Lond—July 29, 1910. No. 16253 A.

Automobile Fire Apparatus (Kraftwagen im Dienst der Feuerwehr). Herr Lehmann. Compares steam, electric and combustion-motor operation. 2500 w. Zeitschr d Ver Deutscher Ing—July 2, 1910. No. 16781 D.

Fuel Systems.

The Pressure Feed System on Motor Cars. Harold Whiting Slauson. Diagram and description of the arrangement and function of its parts. 3000 w. Motor Car Jour—Aug. 20, 1910. No. 16660 A.

Gear Boxes.

Gear Boxes on Back Axles. An impartial discussion with conclusions. 1500 w. Autocar—Aug. 13, 1910. No. 16481 A.

Why Are Gear Boxes Noisy? Suggests various lines of investigation to solve the problem. 3000 w. Autocar—Aug. 6, 1910. No. 16338 A.

Gears.

Transmission of an Automobile. K. W. Najder. Mathematical. 500 w. Automobile—Aug. 18, 1910. No. 16448.

Graham Differential. Illustrates and describes details of design and construction of this gear of the overhauling type. 900 w. Automobile—Aug. 25, 1910. No. 16653.

Halladay.

The Halladay Automobile for 1911. Illustrated description of a car so made that it can be converted from a touring car to a fore-door type. 1500 w. Automobile—Aug. 25, 1910. No. 16654.

Hillman.

The 12-15 H. P. Hillman Car. Illustrated description, especially explaining the lubricating system. 1200 w. Autocar—July 30, 1910. No. 16229 A.

Ignition.

Automatic Ignition Advance. Illustrated description of a German system. 700 w. Autocar—July 30, 1910. No. 16230 A.

Lighting.

A Permanent-Magnet Car Dynamo. Illustrates and describes the characteristics of this dynamo. 1200 w. Auto Jour—July 23, 1910. No. 16124 A.

Lubrication.

Car-Motor Ideal Lubrication. Hugh Dolnar. A review of the various systems of lubrication for automobile motors, favoring the continuous oil circulating system. Ills. 2500 w. Am Mach—Vol. 33. No. 32. No. 16278.

Semi-Automatic Drip-Feed Lubricator. Illustrated description of a new type intended primarily for motor cycles and small cars. 600 w. Engr, Lond—July 29, 1910. No. 16255 A.

See also Lubricants, under POWER AND TRANSMISSION.

Motors.

Some Foreign Piston Valve Motors. Illustrates and describes recent English and French designs brought out mainly with the view of eliminating valve noises and increasing the power. 1500 w. Horseless Age—Aug. 3, 1910. No. 16186.

Motor Valves.

Slide, Rotary and Piston vs. Poppet Valves. Eugene P. Batzell. Read at meeting of Soc. of Auto. Engrs. Detailed discussion of the merits of various types, and the trouble with noise in poppet valves. 1800 w. Automobile—Aug. 4, 1910. Serial. 1st part. No. 16182.

Omnibuses.

The Motor-Omnibus Concession in Paris (La Concession des Autobus de Paris). Lucien Férissé. Discusses the terms of the concession, the experience of other cities, economic aspects of motor-omnibus traffic, and the construction of the vehicles. Ills. 30000 w. Mem Soc Ing Civ de France—June, 1910. No. 16510 G.

Peugeot.

The 10-14 H. P. Peugeot Model. Illustrated detailed description. 1200 w. Auto Jour—Aug. 13, 1910. No. 16483 A.

Road Resistance.

Measurements of Road Resistance of Automobiles. H. E. Wimperis. Reports two road resistance tests made by the author. 700 w. Eng News—Aug. 4, 1910. No. 16174.

Road Trains.

The New Daimler Road Train. Illustrated detailed description of the improved Renard train and its operation. 3500 w. Auto Jour—July 30, 1910. No. 16231 A.

Speed.

Judging a Car's Speed. Charles B. Hayward. Shows that many factors tend to make the estimates unreliable. 2000 w. Horseless Age—Aug. 17, 1910. No. 16453.

Starting.

Starting on the Spark. Dr. Charles W. Snyder. Considers the theory of starting a multi-cylinder engine by simply manipulating the spark lever and factors determining the success of the operation. 1000 w. Horseless Age—Aug. 24, 1910. No. 16681.

Supplies.

The Carrying of Tools, Spare Tires and Supplies. H. H. Brown. Extracts from a paper read at S. A. E. convention, explaining practical methods tending to secure cleanliness, convenience and economy. Ills. 1800 w. Automobile—Aug. 4, 1910. No. 16180.

Taximeters.

Taximeters and Their Operation. Douglas R. Hobart. Explanation, with diagrams. 2000 w. Horseless Age—July 27, 1910. No. 16053.

Tire Pumps.

Automatic Tire Pumps. Illustrates and describes a type worked by suction and compression from the motor cylinder with an air pump in tandem relation. 1000 w. Automobile—Aug. 25, 1910. No. 16650.

Tractors.

Tractors at the Royal Agricultural Society's Trials at Baldock. Illustrated brief descriptions of the Mann agricultural motor, the Ivel agricultural motors, and the Wallis and Steevens steam tractor. 1000 w. Engng—Aug. 12, 1910. No. 16602 A.

The Saunderson Agricultural Tractors. Illustrated description of two tractors which took part in the trials of the Royal Agricultural Society, with editorial. 2800 w. Engng—Aug. 19, 1910. No. 16718 A.

Traction Plowing Outfits—Operating

Methods and Costs. L. W. Ellis. From Bul. No. 170 U. S. Dept. of Agri. Detailed discussion of factors affecting the economy. 7000 w. Engng-Con—Aug. 24, 1910. No. 16623.

COMBUSTION MOTORS.

Aeronautic Motors.

French Aeroplane Motors. Warren H. Miller. An illustrated review of six leading types. 2500 w. Engineering Magazine—Sept., 1910. No. 16744 B.

Gas-Engine Tests.

Gas-Engine Test Records. W. A. Tookey. Remarks on the worthlessness of test figures, and discussing the question of frictional horse-power in the present number. 3000 w. Mech Wld—Aug. 19, 1910. Serial. 1st part. No. 16699 A.

Gasoline Engines.

A New Departure in Two-Stroke Engines. Illustrated description of a novel type of two-stroke gasoline engine, designed by G. Enderby and H. Johnson. 1000 w. Sci Am Sup—Aug. 20, 1910. No. 16433.

Gas Power Plants.

Suction Gas Plants in Western Australia. M. von Bernewitz. Descriptive notes collected on visiting all the plants at work. 3000 w. Min Jour—July 30, 1910. No. 16242 A.

Gas Producers.

Gas Producers. J. Hofmann. Abstract of a paper before the Int. Cong. at Dusseldorf. Discusses the requirements of a good producer and illustrates and describes types. 3000 w. Ir & Coal Trds Rev—July 22, 1910. No. 16154 A.

Deutz Suction Gas Producers (Gazogènes aspirants de la Gasmotorenfabrik de Deutz près Cologne). Describes briefly the two types, for coke or anthracite, and for lignite briquettes. Ills. 2000 w. Génie Civil—July 23, 1910. No. 16551 D.

Producer Gas.

American Producer Gas Practice. A. J. McCarte. Awarded the Mary Starr Stillman prize in Applied Technology, 1910. A review of the industry, discussing fuels used for gas producers. 2500 w. Stevens Ind—July, 1910. Serial. 1st part. No. 16388 D.

HEATING AND COOLING.

Central Plants.

The Profitable Operation of a Central Heating Station Without the Assistance of Electrical or Other Industries. Byron T. Gifford. Read before the Nat. Dist. Heat. Assn. Gives a statement showing that such a plant may be made a physical and a financial success. Discussion. 2500 w. Heat & Vent Mag—Aug., 1910. No. 16405.

Central Heating at Crawfordsville, Ind. Illustrated description of a hot-water heating system designed for 300,000 sq. ft. of radiation; steam-turbine water-circulating pumps, and air suction for removing ashes. 3500 w. Met Work—July 30, 1910. No. 16045.

Cooling Towers.

The Testing of Cooling Towers. Wilfred Yorke. Shows how the data were obtained and calculated, and how more efficient service could have been obtained. 1500 w. Power—Aug. 30, 1910. No. 16735.

Fans.

Tests of Ventilating Fans (Untersuchungen an Ventilatoren für Lüftungsanlagen). K. Brabbée and M. Berlowitz. Describes methods and gives results of fan tests at the Berlin Technical High School. Ills. 5500 w. Zeitschr d Ver Deutscher Ing—July 30, 1910. No. 16789 D.

Hot Air Heating.

Tests of Cast-Iron Hot Blast Heaters. L. C. Soule. Explains new methods of testing and gives a new formula designed to cover all hot-blast heating conditions. Ills. 2000 w. Heat & Vent Mag—Aug., 1910. No. 16406.

Plumbing.

Plumbing of Federal Buildings. Nelson S. Thompson. Describes government practice in the plumbing, drainage and water supply of buildings erected under control of the supervising architect. 2000 w. Met Work—Aug. 27, 1910. Serial. 1st part. No. 16671.

Fixing Iron or Copper Pipes for Hot Water. J. Wright Clarke. Suggestions for satisfactory work, illustrating appliances used. 1800 w. Dom Engng—Aug. 13, 1910. No. 16367.

Refrigeration.

Cold and Its Production. F. E. Matthews. Discusses heat, its effects, units by which it is measured, laws governing its flow, and applications to refrigeration. 3500 w. Power—Aug. 2, 1910. No. 16071.

Mechanical Refrigeration. F. E. Matthews. Short review of the history of the development. 2500 w. Power—Aug. 9, 1910. No. 16261.

Mechanical Refrigeration. F. E. Matthews. An elementary treatment of commercial systems with simple illustrations to show the principles of operation. 3500 w. Power—Aug. 23, 1910. No. 16470.

New Vacuum Machine. Illustrates and describes a French ice machine in which the vacuum is produced by a steam jet and a vacuum condenser. 1800 w. Ice & Refrig—Aug., 1910. No. 16204 C.

Absorption Machine Problems. Robert H. Kirk and H. Sloan. Gives diagrams for calculations and examples showing their use. 2000 w. Ice & Refrig—Aug., 1910. No. 16206 C.

Baker Chocolate Cooling Plant. Details of the refrigerating plant in the factories at Dorchester, Mass., are illustrated and described. 1500 w. Ice & Refrig—Aug., 1910. No. 16205 C.

The Precooling Plants of the Pacific Fruit Express Company. Illustrated description of plants recently built in California, which provide for the passage of large volumes of cold air through loaded cars before they are iced. 3000 w. Eng Rec—July 30, 1910. No. 16060.

HYDRAULIC MACHINERY.

Centrifugal Pumps.

A New Centrifugal Pump. Illustrates and describes types of the Hayward-Tyler turbo pump. 800 w. Engr, Lond—July 22, 1910. No. 16151 A.

Clearance Losses in Fans and Centrifugal Pumps (Der Spaltverlust bei Ventilatoren und Kreiselpumpen). M. Vidmar. Mathematical. Ills. Serial. 1st part. 2500 w. Zeitschr f d Gesamte Turbinenwesen—July 30, 1910. No. 16751 D.

Exhibitions.

German Hydraulic Engineering at the Brussels Exhibition Describes a very interesting exhibit. 2500 w. Engng—Aug. 19, 1910. No. 16717 A.

Gas Pumps.

The Humphrey Gas-Pump. Illustrated description of an internal-combustion pump shown at the Brussels exhibition. 2000 w. Engng—July 22, 1910. No. 16142 A.

Pumping Plants.

Combined Fire and Domestic Service Pumping Plants. Brief illustrated description of two small installations in California. 900 w. Eng Rec—Aug. 27, 1910. No. 16668.

Pumps.

A New Boiler Feed Pump. Illustrates and describes a direct-acting feed pump with a new form of valve gear. 1000 w. Engr, Lond—Aug. 19, 1910. No. 16722 A.

Surges.

The Theory of Surges (Sulla Teoria della "Houle"). P. Alibrandi. A mathematical study. Ills. 6500 w. Ann d Soc d Ing e d Arch Ital—July 15, 1910. No. 16560 F.

Turbine Governing.

The Indirect Regulation of Turbines with Special Reference to the Inertia of the Water (Die indirekte Regulierung der Turbinen mit Berücksichtigung der Massenträgheit des Zuflusswassers). J. Magg. Mathemtaical. Ills. Serial. 1st part. 3500 w. Zeitschr f d Gesamte Turbinenwesen—July 10, 1910. No. 16599 D.

Turbines.

Hydraulic Turbines for 670-Foot Head. H. Birchard Taylor. Describes two 6000-h.p. reaction turbines to be operated under a 670-foot head at Noriega, Mex. Ills. 3000 w. Am Mach—Vol. 33. No. 33. No. 16421.

Water Hammer.

The Calculation of Water Hammer in Conduits under Pressure (Note sur le Calcul du Coup de Bélier dans les Conduites d'Eau sous Pression). A. Vaucher. A mathematical exposition of Alliévi's theory. Serial. 1st part. 2300 w. Bul Tech d l Suisse Romande—July 10, 1910. No. 16534 D.

Water Wheels.

Effect of the Length of Penstock on the Weight of Revolving Parts of a Water-Wheel Unit. George M. Peek. Mathematical discussion, developing and applying formulae. 1200 w. Eng News—Aug. 11, 1910. No. 16314.

The Testing of Water Wheels After Installation. Discussion of C. M. Allen's paper. 5500 w. Jour Am Soc of Mech Engrs—Aug., 1910. No. 16299 F.

MACHINE ELEMENTS AND DESIGN.

Ball Bearings.

Construction and Use of Ball-Bearings. J. D. Waern. Read before the Vic. Inst. of Elec. Engrs. Discusses roller and ball-bearings, analyzing losses in them by friction and the rules governing their construction. 2000 w. Aust Min Stand—July 6, 1910. Serial. 1st part. No. 16417 B.

Bearings.

See also Bearing Metals, under MATERIALS OF CONSTRUCTION.

Designing.

The Designers' Tools (L'Outillage technique et pratique du Dessinateur). Jean Escard. The first part describes and discusses draughting tables and boards. Ills. Serial. 1st part. 4500 w. Rev de Mécan —July, 1910. No. 16524 E + F.

Gears.

Interchangeable Involute Gearing. Wilfred Lewis. Suggests a system having a pressure angle of 22½ degrees, and an addendum of 0.278 of the circular pitch. Ills. 3300 w. Jour Am Soc of Mech Engrs—July, 1910. No. 16418 F.

Tooth Gearing. J. D. Steven. A discussion of involute gear teeth and the advantage of a uniform tooth. Ills. 4000 w. Inst of Mech Engrs—July, 1910. No. 16248 N.

Special Bevel Gears. F. E. Watts. Discusses principles involved in their layout, and methods of calculation. 800 w. Horseless Age—Aug. 3, 1910. No. 16185.

Riveted Joints.

The Strength of Riveted Joints. Patrick J. Sweeney. Explanation given by a foreman boiler maker to his apprentices. Ills. 2500 w. Boiler Maker—Aug., 1910. No. 16264.

Eccentrically Loaded Bolt and Rivet Groups. M. Terry. A mathematical discussion of the principles involved in designing riveted joints. 800 w. Mach, N Y —Aug., 1910. No. 16104 C.

See also Steel, under CIVIL ENGINEERING, MATERIALS OF CONSTRUCTION.

MACHINE WORKS AND FOUNDRIES.

Automatic Machines.

Slide Rule in Screw Machine Work. George D. Hayden. Shows how accurate results can be easily and quickly obtained. 1500 w. Am Mach—Vol. 33. No. 34. No. 16615.

Balancing Machine.

Principles of Running Balance. Presents results and conclusions from tests made on a Norton running balance machine. Ills. 4500 w. Am Mach—Vol. 33. No. 32. No. 16276.

Brass Founding.

Why Brass Castings Often Fail. A. Napier, in *Found. Trd. Jour.* Discusses some of the essentials for good work. 2000 w. Mech Wld—Aug. 19, 1910. No. 16701 A.

Case Hardening.

Theoretical and Practical Notes on Case Hardening (Quelques Observations théoriques et practiques sur la Cémentation). L. Guillet. Read at the Düsseldorf Congress Discusses cementing materials, time, temperature, etc. 2200 w. Rev de Métal—July, 1910. No. 16515 E + F.

Heat Treatment of Cemented Products (Traitements Thermiques des Produits Cémentes). L. Guillet. Read at the Düsseldorf Congress. Discusses the tempering of case-hardened materials. Ills. 2500 w. Rev de Métal—July, 1910. No. 16516 E + F.

Castings.

Runners, Gates, and Dirty Castings. Considers especially the sources of dirt and the means of securing clean castings. Ills. 2500 w. Mech Wld—July 22, 1910. No. 16138 A.

Sinking Heads and Sound Castings. Thomas Kennedy. Read before the Assn. of Water Engrs. Brief discussion of the effect of a sinking head on large castings, showing the advantages and desirability. Ills. 800 w. Engng—July 22, 1910. No. 16146 A.

Pickling Castings and Dips Used. Gives receipts for obtaining different kinds of finish. 1000 w. Am Mach—Vol. 33. No. 34. No. 16614.

Distortions in Castings (Ueber das Krummziehen von Gussstücken nach dem Gusse). H. Vetter. Discusses the causes of the distortion of castings on cooling. Ills. Serial. 2 parts. 2500 w. Giesserei-Zeit—July 1 and 15, 1910. No. 16583 each D.

Cupola Practice.

Notes on the Melting of Iron in Cupolas. A. J. Ehrob. Explanation of the changes brought about in the cupola and their regulation. 3000 w. Foundry—Aug., 1910. No. 16082.

Cutting Tools.

Multiple Cutter Tools. W. S. Giele. Discusses the considerations governing the number of cutting edges in a boring or turning tool. 1500 w. Mach, N Y—Aug., 1910. No. 16103 C.

Enamelling.

An Investigation of Enamel for Cast Iron (Untersuchungen von Gusseisen-Emails). Julius Grünwald. Reports results and conclusions of a large number of tests. 3500 w. Stahl u Eisen—July 13, 1910. No. 16579 D.

Forging.

Influence of Improvements in Heating Furnaces on the Development of Mechanical Forging (Influence du Perfectionnement des Méthodes de Chauffage sur le Développement du Forgeage mécanique). MM. Androuin and Stein. Read at the Düsseldorf Congress. 3000 w. La Métal—July 27, 1910. No. 16543 D.

Forging Presses.

High Speed Forging Press. Explains the advantages and gives an illustrated description of machines developed by Davy Bros., Inc. of Sheffield, Eng. 1700 w. Am Engr & R R Jour—Aug., 1910. No. 16197 C.

Foundries.

The Equipment of a Modern Specialty Foundry. Illustrated description of fittings used in a foundry at Providence, R. I., where fire extinguishing apparatus is made. 1500 w. Castings—Aug., 1910. No. 16415.

A Modern Railroad Repair Foundry. Illustrated description of the new casting shop of the D., L. & W. R. R. at Scranton, Pa. 1500 w. Foundry—Aug., 1910. No. 16084.

Foundry Coke.

Coke and It's Properties. F. K. Knowles. Read before the British Found. Assn. Information from the laboratory and from the practical coke user. 3500 w. Col Guard—Aug. 19, 1910. No. 16711 A.

Coke and Its Properties. F. K. Knowles. Read before the British Found. Assn. Considers the points upon which the chemist can give information, and the selection of coke by the practical coke user, etc. 3000 w. Mech Engr—Aug. 12, 1910. No. 16497 A.

Foundry Materials.

The Comparative Values of Foundry Annealing Ores. F. H. Hurren. Gives analyses of typical ores, and discusses the right composition. 800 w. Ir & Coal Trds Rev—Aug. 19, 1910. No. 16726 A.

Foundry Practice.

Bell Founding in Old France. Joseph G. Horner. Illustrated description of practice previous to 1777. 1500 w. Mach, N Y—Aug., 1910. No. 16110 C.

Present Status of Foundry Practice in Germany (Ueber den heutigen Stand des Giessereiwesens in Deutschland). C. Irresberger. Read at the Düsseldorf Congress. Ills. 3500 w. Stahl u Eisen—July 13, 1910. No. 16577 D.

Furnaces.

Oil Burning Melting Furnace. H. A. Evans. Illustrated description of a furnace made of sheet metal and structural steel, lined with fire brick with a hearth of dolomite. 1500 w. Am Mach—Vol. 33. No. 34. No. 16613.

Gear Cutters.

Making Cutters for Gear Teeth. F. A. Stanley. Illustrates and describes special machines and appliances and their manufacture. 2500 w. Am Mach—Vol. 33. No. 34. No. 16610.

Grinding.

Grinding Automobile Cylinders. James N. Heald. Gives some problems in automobile building, which have been solved by the grinding machine. 4000 w. Am Mach—Vol. 33. No. 32. No. 16280.

Grinding Machines.

Grinding Machinery and the Manufacture of Grinding Wheels. John H. Davy. Read before the Glasgow Tech. Col. Sci. Soc. Information concerning the development of grinding machines, the abrasives used, their manufacture, etc. Ills. 4500 w. Mech Engr—Aug. 5, 1910. No. 16348 A.

Jigs.

Pertinent Points on Jig and Fixture Design. C. Nosrac. Notes on materials, devices, and methods. 1800 w. Mach, N Y—Aug., 1910. No. 16107 C.

Lathes.

A Double-Bedded Turbine Lathe. Illustrated description of the Harvey turbine lathe. 1000 w. Engr, Lond—Aug. 5, 1910. No. 16361 A.

A New High-Speed Wheel Lathe. Illustrated description of a machine supplied by Loudon Brothers, Ltd., to the Central South African Railways. 1000 w. Engr, Lond—July 29, 1910. No. 16256 A.

3¾-In. and 4½-In. Screw-Cutting Foot-Lathes. Illustrates and describes two new models introduced by the Britannia Engng. Co. 700 w. Engng—Aug. 19, 1910. No. 16719 A.

Machine Tools.

High-Speed Tools and Machines to Fit Them. H. I. Brackenbury. Remarks on high-speed tool steel, its use and applications, and the machines fit for its use. Ills. 6000 w. Inst of Mech Engrs—July, 1910. No. 16250 N.

Machine Tools at the Brussels Exhibition (Die Werkzeugmaschinen auf der Brusseler Weltausstellung 1910). Franz Adler. A preliminary report. Ills. 4000 w. Zeitschr d Ver Deutscher Ing—July 16, 1910. No. 16784 D.

Metal Cleaning.

The Metal-Cleaning Plant at the A. E. G. Cable Works at Oberspree (Die Metallteil-Beizerei im Kabelwerk Oberspree der Allgemeinen Elektricitäts-Gesellschaft). Franz Adler. Detailed description of a plant for cleaning copper wire. Ills. 2000 w. Zeitschr d Ver Deutscher Ing—July 30, 1910. No. 16791 D.

Milling.

Locating Indicator for the Miller. George J. Murdock. Illustrated description of a device for locating jigs and other tool work on the milling-machine table. Gives details of construction and method of applying to various classes of work. 1200 w. Am Mach—Vol. 33. No. 34. No. 16611.

Molding.

Cylinder Molding in an English Shop. Illustrates and describes the method of molding locomotive cylinders in the foundry operated by the Midland Ry. Co., Derby, England. 3000 w. Foundry—Aug., 1910. No. 16081.

Molding a Marine Engine Bed Plate. Joseph Horner. Illustrated explanation of the method of constructing the pattern and core boxes, making and setting the cores and finishing the mold. 1500 w. Foundry—Aug., 1910. No. 16083.

Molding a Steam Turbine Cylinder. Explains how the copes are prepared, finished and rammed, and the cores made up. Ills. 2000 w. Am Mach—Vol. 33. No. 34. No. 16616.

Molding Sand.

Magnetic Separation of Iron Particles from Molding Sand (Die elektromagnetische Separation von Formsand und eisenhaltigen Stoffen im Giessereibetriebe). Hubert Hermanns. Describes the methods and machines used. Ills. Serial. 1st part. 1800 w. Giesserei-Zeit—July 1, 1910. No. 16584 D.

Pattern Making.

Making a Pattern for a Steam Turbine. E. F. Lake. Illustrates and describes pattern-construction methods employed in a large shop on steam turbines. 2000 w. Am Mach—Vol. 33. No. 32. No. 16281.

Patterns.

Latter-Day Methods of Gating Metal Patterns. W. R. Dean. Describes the operations in detail. Ills. 2500 w. Foundry—Aug., 1910. No. 16085.

Pipe Lining.

Lead Lined Tubing. Holden A. Evans. Illustrates and describes the machinery and methods used. 2200 w. Am Mach—Vol. 33. No. 31. No. 16163.

Presses.

Pressing and Stamping (Matriçage et Découpage). A review of recent patents and literature relating to drawing presses, etc. Ills. 7500 w. Rev de Mécan—July, 1910. No. 16525 E + F.

Shop Appliances.

Dies Used in Making Fishing Reels. E. A. Dixie. Illustrates and describes tools for making reel-body ends and novel method of driving them in the lathe. 800 w. Am Mach—Vol. 33. No. 33. No. 16419.

Designing Screw Machine Tools and Cams. Douglas T. Hamilton. Describes methods employed in designing special tools and cams for the Brown & Sharpe automatic screw machine. Ills. 3500 w. Mach, N Y—Aug., 1910. No. 16108 C.

Shop Design.

The Routing Diagram as a Basis for Laying Out Industrial Plants. Charles Day. Shows the importance of the right arrangement of departments and equipment. Ills. 4000 w. Engineering Magazine—Sept., 1910. No. 16737 B.

Shop Heating.

The Heating of Engineering Shops. Illustrates and describes the heating apparatus installed in the shops of the Central London Railway. 1500 w. Engng—Aug. 19, 1910. No. 16716 A.

The Heating, Ventilating and Air-Conditioning of Factories. Percival Robert Moses. This second article considers the regulation of humidity, air-washing, and costs. Ills. 4500 w. Engineering Magazine—Sept., 1910. No. 15743 B.

Shop Practice.

Machine Work in the Oil Country—Making "Joints." Illustrates and describes oil-well tools and their making. 1500 w. Mach, N Y—Aug., 1910. No. 16111 C.

Cam Shaft Milling in the Lathe. H. M. York. Illustrates and describes a method of machining cams on their shafts by means of special holding fixtures and a milling attachment used in the engine lathe. 1000 w. Am Mach—Vol. 33. No. 31. No. 16164.

Machining Magnet and Stator Frames. W. Burns. A short description. Ills. 2200 w. Mech Wld—Aug. 5, 1910. No. 16350 A.

Making Open-Side Planers. Ethan Viall. Illustrated description of details introduced at the Cleveland Planer Works. 600 w. Mach, N Y—Aug., 1910. No. 16106 C.

Steel Balls. J. F. Springer. Illustrates and describes methods employed by the Standard Roller Bearing Co. in their manufacture. 2500 w. Ir Age—Aug. 11, 1910. No. 16269.

Shop Kinks. Illustrated description of devices and methods used in the Silvis Shops of the Rock Island lines. 1500 w. Ry Age Gaz—Aug. 5, 1910. No. 16193.

Shops.

New Factory of the Frank Mossberg Co. Chester L. Lucas. Illustrated description of new tool works in Attleboro, Mass. 2500 w. Mach, N Y—Aug., 1910. No. 16105 C.

The Works of Messrs. Alfred Herbert, Limited, Coventry. Illustrated detailed description of these important English machine-tool works. Plates. 10600 w. Engng—July 22, 1910. No. 16140 A.

The Works of Messrs. Haniel and Lueg, Düsseldorf. Illustrated detailed description of important industrial works in Germany. 1000 w. Col Guard—Aug. 19, 1910. Serial. 1st part. No. 16710 A.

Shop Ventilation.

The Elimination of Fumes from Dye Works (Installation d'Elimination des Buées dans les Teintureries). Paul Razous. Detailed description of an installation at Lyon, France. Ills. 2000 w. Rev d'Econ Indus—July, 1910. No. 16500 D.

Welding.

Thermit Practice in America in Welding, Casting and Metallurgy. Ernest Stutz. An illustrated discussion of the distinguishing features of the thermit process and its applications. 5000 w. Eng News—Aug. 25, 1910. No. 16628.

Oxy-Acetylene Welding and Cutting. William G. Reyer and R. W. Clark. Illustrates and describes the work. 800 w. Ry Age Gaz—Aug. 5, 1910. No. 16194.

Autogenous Welding Equipments Compared. Henry Cave. Illustrated discussion of the relative merits of the high and low pressure systems. 2200 w. Ir Age—Aug. 4, 1910. No. 16160.

Acetylene and Its Applications (L'Acétylène et ses Applications). P. Rosemberg. A review of the generation of acetylene and of its use for lighting and welding. Ills. 8000 w. Bul Soc d'Ecour—June, 1910. No. 16519 G.

Precautions to be Observed in the Use of Containers of Compressed Gas, Particularly Oxygen and Hydrogen (Sulle Precauzioni da Aversi nell' Uso dei Recipienti Contenenti Gas Liquefatti o Compressi e in Particolare Ossigeno e Idrogeno). C. Giaj-Tenua. Describes the dangers and preventative measures. Ills. Serial 1st part. 1200 w. Industria—July 31, 1910. No. 16569 D.

MATERIALS OF CONSTRUCTION.

Alloys.

The Production of Alloys of Nickel and Cobalt with Chromium. Elwood Haynes. Read before the Am. Chem. Assn. A description of interesting experiments resulting in discovery of an alloy possessing valuable properties. Ills. 2500 w. Ir Trd Rev—Aug. 4, 1910. No. 16177.

The Strength of the Alloys of Electrolytic Iron and Monel Metal. Charles F. Burgess and James Aston. A report of important research work and results. 2500 w. Met & Chem Engng—Aug., 1910. No. 16112 C.

Determination of Lead in Non-Ferrous Alloys. C. P. Karr. Explains methods of assay where lead enters in the course of foundry practice rather than to ores in which lead occurs. 3500 w. Foundry—Aug., 1910. No. 16086.

Alloy Steel.

Cupro-Nickel-Steel. G. H. Clamer, With discussion by John A Mathews. Read before Am. Soc. for Test. Mat. A study of iron-nickel and iron-copper alloys and the joint addition of nickel and copper. 3500 w. Eng News—Aug. 4, 1910. No. 16172.

Silicon Steel. G. A. Bisset. Gives results of tests, showing its superiority over other kinds. Ills. 2500 w. Ir Age—Aug. 25, 1910. No. 16625.

Heat Treatment of Special Steels (Traitements thermiques des Aciers spéciaux). L. Guillet. Read at the Düsseldorf Congress. Deals with perlitic, martensitic, polyhedral, and carbon steels. 3000 w. Rev de Métal—July, 1910. No. 16514 E + F.

Bearing Metals.

Notes on Bearing Metals and the Design of Bearings. S. G. Winn. Discusses the composition of suitable metals and the proper design. 2000 w. Mach Wld—July 22, 1910. Serial. 1st part. No. 16139 A.

Bronzes.

The Elastic Limit of Manganese and Other Bronzes. Discussion of J. A. Capp's paper on this subject. 800 w. Jour Am Soc of Mech Engrs—Aug., 1910. No. 16298 F.

Analysis of Manganese Bronze. H. B. Swan. Outlines a method by which results which check closely were repeatedly obtained. 1200 w. Met & Chem Engng—Aug., 1910. No. 16114 C.

Cast Iron.

Malleable Cast Iron: Some of Its Features and How It Is Manufactured in Sweden. G. A. Blume. Read before the British Foun. Assn. Explains the difference between the Reaumur and American systems, and describes the work as carried on in Sweden. 4000 w. Mech Engr—Aug. 19, 1910. No. 16698 A.

Chromium in Cast Iron (Chrom im Roheisen). Max Orthey. Gives a number of analyses and other data showing its effects. 2000 w. Giesserei-Zeit—July 15, 1910. No. 16585 D.

An Investigation of Ferro-Titanium Thermit and Low-Percentage Ferro-Titanium for Cast Iron and Cast Steel (Versuche mit Ferro-Titan-Thermit und niedrigprozentigem Ferro-Titan für Gusseisen und Stahlformguss). Leonhard Trenheit. A report of tests of the effect of titanium on the strength of iron and steel castings. Ills. 7000 w. Stahl u Eisen—July 13, 1910. No. 16578 D.

Inspection.

Organizing an Inspection Department in an Engineering Works. H. Graham. Suggestions for the inspection department of works where accuracy is important. Ills. 2000 w. Prac Engr—Aug. 12, 1910. No. 16493 A.

Metallography.

A New Metallographic Microscope. William Campbell. Illustrated detailed description. 800 w. Sch of Mines Qr—April, 1910. No. 16479 D.

The Artificial Reproduction of the Widmanstätten Structure in Carbon Steel (Sur la Reproduction artificielle de la Structure de Widmanstätten dans l'Acier au Carbone) Nicolas Belaiew. Illustrates results of attempts to produce the structure observed by Widmanstätten in meteorites in alloy steels. 3000 w. Rev de Mètal—July, 1910. No. 16517 E + F.

Steel.

A Research on the Hammer-Hardening of Steel and Industrial Metals (Expériences sur l'Ecrouissage de l'Acier et des Métaux industriels). F. Robin. Gives results and conclusions of a physical and microscopic investigation. Ills. 7500 w. Mem Soc Ing Civ de France—June, 1910. No. 16507 G.

Hammer-Hardening (Remarques sur l'Ecrouissage). Léon Guillet. Comments on M. Robin's paper and on previous researches. Ills. 4500 w. Mem Soc Ing Civ de France—June, 1910. No. 16508 G.

See also Locomotive Construction, under RAILWAY ENGINEERING, MOTIVE POWER AND EQUIPMENT.

MEASUREMENT.

Dynamometers.

An Improved Absorption Dynamometer. Discussion of Prof. C. M. Garland's paper. 700 w. Jour Am Soc of Mech Engrs—Aug., 1910. No. 16297 F.

Elastic Limit.

Elastic Limit by Temperature. Translated extract from a paper by E. Rasch describing a useful application of the principle that when material is stretched it becomes colder and when released again rises to normal. 600 w. Am Mach—Vol. 33, No. 32. No. 16277.

Hardness.

The Hardness Testing of Cast Iron. Richard Mathei. Read before the British Found. Assn. Refers briefly to Turner's, Keep's, and Brinnell's tests, and describes the Shore scleroscope. 2000 w. Mech Engr—Aug. 12, 1910. No. 16496 A.

Hardness Tests on Alloys of Nickel and Copper with Electrolytic Iron. G. A. Roush. Reports on investigation for determining the hardness, using the scleroscope method devised by Albert F. Shore in 1906. 1700 w. Met & Chem Engng—Aug., 1910. Serial. 1st part. No. 16115 C.

Load Meter.

A Load Meter for Piston Engines Working under Variable Load (Leistungszähler für Kolbenmaschinen mit beliebig veränderlicher Belastung). Anton Böttcher. Describes the theory and construction of a device designed by the author. Ills. 6000 w. Zeitschr d ver Deutscher Ing—July 23, 1910. No. 16788 D.

Pitot Tubes.

Rating of Pitot Tubes. H. C. Berry. Describes the methods employed in rating the tubes used in the measurement of the quantity of water passing into the penstocks of the Ontario Power Co. Ills.

Discussion. 10000 w. Pro Engrs Club of Phila—July, 1910. No. 16393 D.

Pressure Gauges.

Two-Liquid Differential Gauge. Jas. Alex. Smith. Illustrated description of a simple, sensitive, two-liquid gauge for measuring small pressures, giving some applications. 1600 w. Engng—July 22, 1910. No. 16147 A.

The Accuracy of Spring Pressure Gauges (Der Genauigkeitsgrad der Federmanometer). G. Klein. Records a number of tests of gauges of this type. Ills. 3500 w. Zeitschr d Ver Deutscher Ing—July 30, 1910. No. 16792 D.

Pyrometry.

Recent Advances in Pyrometry. R. S. Whipple. Discusses gas thermometry, resistance thermometry, thermo-electric pyrometry, and radiation pyrometry, describing recent developments in each. 3000 w. Elect'n, Lond—July 22, 1910. No. 16128 A.

The Pyrometer, Its Development and Use. William H. Bristol. Reviews the history of various types, discussing their use in the laboratory and the necessity for more sturdy instruments for practical work, and describes the Bristol type of instrument. 1800 w. Automobile—Aug. 4, 1910. Serial. 1st part. No. 16181.

Measurement of High Temperatures. A. R. Maujer. Illustrates and describes six different types of pyrometers for boiler plant use. 2400 w. Power—Aug. 2, 1910. No. 16070.

Vulgarized Pyrometry. Marius C. Krarup. Explains how the heat of steel may be measured accurately by improved methods for color comparison. 1800 w. Automobile—Aug. 18, 1910. No. 16449.

Selecting and Using Pyrometers. C. Conam. Considers thermocouple and resistance types. 1200 w. Power—Aug. 30, 1910. No. 16734.

Units.

The Horse-Power. H. M. Phillips. Discusses general notions of power development and measurement. 3500 w. Cassier's Mag—Aug., 1910. No. 16292 B.

Wind Pressures.

The Eiffel Aero-Dynamometric Installation. Illustrates and describes the apparatus installed near the Tour Eiffel for procuring data concerning wind pressures, and the method of experimenting. 2000 w. Engr, Lond—Aug. 5, 1910. No. 16357 A.

POWER AND TRANSMISSION.

Air Compressors.

Single-Stage Single-Acting Air-Compressor. Illustrates and describes a new English design. 1200 w. Engng—July 22, 1910. No. 16141 A.

Belt Driving.

Belt Design Notes and Diagrams. William Manktelow. Gives diagrams with explanation of their use. 1000 w. Mech Wld—Aug. 19, 1910. No. 16700 A.

Cork Inserts for Automobile-Making Machinery. Lawrence Whitcomb. Read at meeting of Soc. of Auto. Engrs. Shows their value in eliminating losses in power transmission, their applications and the results. 1500 w. Automobile—Aug. 4, 1910. No. 16179.

Costs.

The Cost of Steam Power in a Mill Plant. Howard S. Knowlton. Gives results of a test in a large mill plant which was maintained 14 continuous days and nights. 1800 w. Eng Rec—Aug. 13, 1910. No. 16328.

Electric Driving.

Steam Engine vs. Motor Drive for Small Machine Shops. A. G. Popcke. Showing the advantages of the motor drive by a comparison of the two systems. 2000 w. Elec Jour—Aug., 1910. No. 16385.

Symposium on Electric Driving in Machine Shops. Discussion of the papers presented by A. L. DeLeeuw, Charles Fair, Charles Robbins, and John Riddell. Ills. 13000 w. Jour Am Soc of Mech Engrs—Aug., 1910. No. 16300 F.

Lubricants.

Necessary Reform in Specifications for Petroleum Products. Dr. Albert Sommer. Presented before the Am. Soc. for Test. Mat. Shows that reforms are an urgent necessity, with suggestions. 4000 w. Eng Rec—Aug. 6, 1910. No. 16222.

Lubricants for Automobiles (Die Schmiermittel und ihre Bedeutung für den Fahrbetrieb). G. Wolff. Discusses the properties of various lubricants, with special reference to their use in motor cars. 5000 w. Zeitschr d Mit Motorwagen Ver—July 31, 1910. No. 16754 D.

Parallel Operation.

The Behavior of Prime Movers in Mechanical or Electrical Parallel Operation (Ueber das Verhalten von Kraftmaschinen im mechanischen oder elektrischen Parallelbetrieb). Otto Ohnesorge. A general consideration of the problem of parallel operation. Ills. 2600 w. Zeitschr d Ver Deutscher Ing—July 30, 1910. No. 16790 D.

Rope Driving.

The Design of Rope Drives. Francis H. Davies. Discusses the influences of length and angle of drive, form of groove, ratio of pulley diameters, speed, size and character of rope. Ills. 2500 w. Power—Aug. 16, 1910. No. 16374.

Shaft Bearings.

Ball-Bearing Lineshaft-Hangers. Discussion of paper by Henry Hess. 2500 w. Jour Am Soc of Mech Engrs—Aug., 1910. No. 16296 F.

Shafting.

The Erection of Machine-Shop Shafting. George W. Burley. Discusses the arrangement of the machines and shafting, methods of fixing the position of shafting and hangers, supporting hangers, etc. Ills. 2500 w. Mech Wld—July 29, 1910. Serial. 1st part. No. 16245 A.

STEAM ENGINEERING.

Boiler Draft.

Balanced Draft in Steam-Boiler Practice (Un nouveau Mode de Fonctionnement économique des Foyers de Générateurs à Vapeur et autres Réalisé par le "Tirage équilibré"). Serge Heryngfet. Describes the system, discusses its economy, and reports tests. Ills. 8800 w. Mem Soc Ing Civ de France—May, 1910. No. 16505 G.

Boiler Efficiency.

Air Supply and Boiler Efficiency. A. B. McIntyre. Gives method of figuring furnace temperature due to complete combustion; also loss due to incomplete combustion because of insufficient air supply. 3000 w. Power—Aug. 30, 1910. No. 16733.

Fire and Water Tube Boilers. William Westerfield. Shows that soot does not affect the efficiency of one more than the other. Ills. 1200 w. Power—Aug. 23, 1910. No. 16471.

Boiler Explosions.

Boiler Explosions and Their Causes. G. W. Buckwell. Read before the Barrow & District Assn. of Engrs. Discusses the various theories that have been advanced to account for explosions, and gives a review of a number of explosions and their causes. 4500 w. Mech Wld—July 29 & Aug. 5, 1910. 2 parts. No. 16349, each A.

A Remarkable Explosion. An illustrated account of the explosion in the s. s. Anglo-Saxon on the 31st of Dec., 1909, when the ship was off Cape Palliser, New Zealand. 700 w. Engr, Lond—Aug. 12, 1910. No. 16606 A.

Boiler Firing.

Economical Fire Room Methods. F. R. Low. Illustrated account of a hand-fired plant in which some remarkable results were obtained. 3000 w. Power—Aug. 2, 1910. No. 16069.

Boiler Fittings.

A New Feed-Water Regulator. Illustrated detailed description of the Crosby regulator. 1200 w. Engr, Lond—Aug. 12, 1910. No. 16605 A.

Boiler Management.

The Selection, Use and Abuse of Steam Boilers. Byron Cummings. From an address at York, Pa., before the Mfrs.' Assn. Refers to boilers and plants of size used by the average manufacturer. Ills. 6500 w. Boiler Maker—Aug., 1910. No. 16265.

Boiler Rating.

Testing Heating Boilers. An illustrated account of how a cast iron boiler was studied under conditions intended to fix the proper rating. 3000 w. Met Work—Aug. 20, 1910. No. 16447.

Boilers.

The Nesdrum Water-Tube Boiler. Illustrated description. 500 w. Mech Engr—July 29, 1910. No. 16244 A.

De Naeyer's Boilers with Underfeed Stokers at the Brussels Exhibition. Illustrated description. 1000 w. Engng—Aug. 5, 1910. No. 16354 A.

The Present Status of the Sectional Boiler Industry (Der gegenwärtige Stand der Gliederkesselindustrie). Herr Pradel. Describes and discusses various types of sectional heating boilers. Ills. 6000 w. Zeitschr d Ver Deutscher Ing—July 23, 1910. No. 16787 D.

Boiler Troubles.

Grooving in Steam Boilers. W. H. Booth. Explains the cause of grooving and how it may be avoided. 1200 w. Power—Aug. 16, 1910. No. 16376.

Boiler Tubes.

The Influence of Eddy Rings on Boiler Efficiency (Einfluss der Wirbelringe auf den Nutzeffekt der Kessel). Carl Züblin. Describes tests of boilers equipped with the Pielock eddy rings. Ills. 2000 w. Schiffbau—July 13, 1910. No. 16593 D.

Boiler Waters.

The Examination of Water by Electrical Methods. W. Pollard Digby. Illustrates and describes a conductivity tube devised for every day engineering work, giving details of tests. 2500 w. Elect'n, Lond—July 29, 1910. No. 16240 A.

Condensers.

Condensers for Small Central Stations. Charles S. Lewis. Read before the Missouri Elec. Gas, St. Ry. & W.-Wks. Assn. Explains the effect of vacuum on the steam consumption of various types of prime movers, and describes recent improvements and their effect in securing higher vacua. Ills. 2000 w. Ir Age—Aug. 11, 1910. No. 16270.

Condensing Water Arrangements. Considers briefly cooling ponds, cooling towers, and the general principles underlying the choice of condensers under various conditions. Ills. 2000 w. Prac Engr—Aug. 5, 1910. Serial. 1st part. No. 16344 A.

Engine Balancing.

The Balancing of Reciprocating Engines. R. J. Grimshaw. Investigates methods of equalizing disturbing forces. Diagrams. 2500 w. Cassier's Mag—Aug., 1910. No. 16291 B.

Engines.

Corliss Engine with Two Eccentrics. R. C. Heck. Discusses the advantage of operating the steam and exhaust-valves by separate eccentrics. Ills. 1200 w. Power—Aug. 16, 1910. No. 16373.

Flue Gas Analysis.

Flue Gas Analysis and Calculation. Julian C. Smallwood. Briefly discusses the molecular theory, shows how to compute the amount of air required to burn a pound of carbon, and how to determine heat losses 2500 w. Power—Aug. 9, 1910. No. 16260.

Fuel Testing.

The Acid Specific-Gravity Test. A. Langerfeld. Information concerning the amount of impurities allowed in the various sizes of anthracite, and the methods of testing for them. 4500 w. Mines & Min—Aug., 1910. No. 16099 C.

Fuels.

Some Considerations on the Fuel Question. G. Basil Barham. Economies in central stations are discussed, especially the use of cheaper fuel and the furnaces for burning them. 2000 w. Elec Rev, Lond—July 29, 1910. No. 16235 A.

Calculating Heat Value of Coal. Julian C. Smallwood. Shows how to calculate the amount of air required to burn a pound of coal based either on approximate or ultimate analysis. Also how to determine the heat value. 5000 w. Power—Aug. 23, 1910. No. 16469.

Heat Transmission.

The Relation between Heat Transmission and Length of Pipe (Die Abhängigkeit der Wärmeübergangszahl von der Rohrlänge). Wilhelm Nusselt. Mathematical. Ills. 5000 w. Zeitschr d Ver Deutscher Ing—July 9, 1910. No. 16783 D.

Rotary Engines.

The Motsinger Rotary Engine. Illustrated description of a three-rotor model combining two engines in one. 2500 w. Ir Age—Aug. 4, 1910. No. 16159.

Smoke Prevention.

The New Smoke Law, Boston. Howard S. Knowlton. A report of the investigation made by the Chamber of Commerce and the bill passed, stating the main provisions of the act. 2300 w. Eng Rec—Aug. 6, 1910. No. 16216.

Steam Accumulators.

A New Regenerative Accumulator. Sectional elevation, plan and description of a patent regenerative accumulator for intermittent steam supply, from high-pressure engines for low-pressure turbines. 1000 w. Ir & Coal Trds Rev—Aug. 12, 1910. No. 16609 A.

Steam Pipes.

Water in Steam May Cause Trouble. W. H. Booth. Describes the action of water in steam and suggests how it may be avoided. 1200 w. Power—Aug. 23, 1910. No. 16468.

Turbine Design.

Dimensions of Steam Turbines. Charles A. Edmonds. Illustrated discussion of the preliminary calculations forming the basis of turbine designs, and cites current practice in dimensioning parts. 3000 w. Power—Aug. 9, 1910. No. 16259.

High-Speed Steam-Turbine Rotor Design and Construction. John McKenzie Newton. Read before the Jun. Inst. of Engrs. Discusses chiefly the mechanical strength and stiffness in relation to the materials of construction. Ills. 3500 w. Mech. Engr—July 22, 1910. No. 16137 A.

Turbine Operation.

Some Features of Steam-Turbine Operation (Etude de quelques Points particuliers du Fonctionnement des Turbines à Vapeur). C. Monteil. Discusses axial pressure, and the laws of mechanical similitude in steam turbines. Ills. 8000 w. Mem Soc Ing Civ de France—June, 1910. No. 16509 G.

Turbine Packings.

On the Theory of Labyrinth Packing. J. Morrow. Read before the Ap. Sci. Sec. of the Univ. of Durham. Gives a method of calculating the leakage in steam-turbine packings. 700 w. Engng—July 22, 1910. No. 16144 A.

Turbines.

Present Steam Turbine Progress. Edwin D. Dreyfus. An illustrated discussion of types and developments in turbines, special features of design, operating conditions, performance, applications, etc. 3500 w. Pro Ry Club of Pittsburgh—May 20, 1910. No. 16381 C.

High Speed Steam Turbines. Edwin D. Dreyfus. Considers changes resulting from the adoption of increased speed ratings. Ills. 1200 w. Elec Jour—Aug., 1910. No. 16384.

A New Steam Turbine. Illustrates and describes turbines manufactured by Franco Tosi, Legnano. 2000 w. Engr, Lond—July 22, 1910. No. 16148 A.

Turbine Tests.

Test of a 15000-K. W. Steam-Engine-Turbine Unit. H. G. Stott and R. J. S. Pigott. Addition to paper, with discussion. Ills. 10000 w. Jour Am Soc of Mech Engrs—Aug., 1910. No. 16295 F.

TRANSPORTING AND CONVEYING.

Cableways.

A Study of Aerial Ropeways (Etude sur les Cables Transporteurs aériens). M. M. Thiery and Cretin. A complete study of their design and construction. Ills. Serial. 1st part. 4500 w. Rev de Mécan—July, 1910. No. 16523 E + F.

Conveyors.

Travelling Dredger Elevator at Shieldhall Sewage Works, Glasgow. Illustrated detailed description of an appliance for the removal of solid matter and mud carried into the catchpit. 800 w. Engr, Lond—July 22, 1910. No. 16149 A.

Cranes.

Electric Locomotive Jib-Crane for Block-Setting. Illustrated description of a crane intended for use either for block-setting or drop-bottom bucket. 500 w. Engng—July 22, 1910. No. 16143 A.

An Eight-Ton Crane Locomotive. Illustrated description. 300 w. Engr, Lond—Aug. 19, 1910. No. 16721 A.

36-Ton Steam Locomotive Breakdown Crane. Illustrated description of a wrecking crane designed to meet difficult conditions. 600 w. Engng—Aug. 5, 1910. No. 16356 A.

Plate-Handling Plant for Shipyards. Illustrated description of an electrically operated, semi-automatic plant recently installed at Newcastle. 1400 w. Ir & Coal Trds Rev—Aug. 19, 1910. No. 16724 A.

Cranes for Railway Service (Grane, insbesondere solche für Eisenbahnbetriebe). Herr Schrader. Describes various types of cranes for construction, wrecking, loading and unloading, and shop purposes. Ills. 4000 w. Glasers Ann—July 15, 1910. No. 16752 D.

Freight Handling.

Clearing House for Goods in London. An illustrated account of the means proposed by A. W. Gattie and A. G. Seaman for the handling and sorting of goods and parcels mechanically. 3500 w. Elect'n, Lond—July 22, 1910. No. 16127 A.

Ore Handling.

Material-Handling Machinery and Its Evolution. E. H. Messiter. A review of the development of such appliances. 1500 w. Min & Sci Pr—July 30, 1910. No. 16183.

MISCELLANY.

Aeronautics.

Recent Aeronautic Competitions (Les récentes Epreuves Aéronautiques). Describes and gives the results of the meet at Rheims, July 3 to 10, 1910. Ills. 8000 w. Génie Civil—July 16, 1910. No. 16548 D.

A Simple Explanation of the Principles Involved in the Wright Patent Suit. Ills. 2000 w. Sci Am—Aug. 13, 1910. No. 16283.

The Figures Behind the Aeroplane. Warren H. Miller. Enumerates the laws of planes moving in air, and of increasing proportions, and gives tabulated data of successful machines. 3000 w. Am Mach—Vol. 33. No. 31. No. 16165.

Industrial Aeroplanes. Marius C. Krarup. Gives improved designs of aeroplanes for securing equilibrium and some new details of construction. Ills. 2000 w. Automobile—Aug. 18, 1910. Serial. 1st part. No. 16450.

Aeroplanes in Naval Warfare (I velivoli nella Guerra navale). Claudio Piumatti. A consideration of their possible usefulness. Ills. 5500 w. Riv Marit—July-Aug., 1910. No. 16555 E + F.

Joseph Michel Montgolfier, a Centenary Study (Joseph Michel Montgolfier, Zum hundertsten Wiederkehr seines Todestages am 28 June, 1810). Dr. Keller. A sketch of the life and work of the inventor of the balloon. Ills. 6600 w. Zeitschr d Ver Deutscher Ing—July 2, 1910. No. 16780 D.

Ordinary and Dirigible Balloons (Palloni ordinari e dirigibili). E. Forlanini. A general historical and technical review. Ills. Serial. 1st part. 1300 w. Industria—July 24, 1910. No. 16568 D.

The Technology of Dirigibles (La Technique des Dirigeables). Capitaine Do. Discusses the general conditions of the problem, the difficulties presented, and the various solutions attempted. Ills. 10500 w. Tech Mod (Sup.)—July, 1910. No. 16527 D.

The Parseval Airship. Carl Dientsbach. Illustrated detailed description of this airship and its handling. 2500 w. Sci Am—Aug. 13, 1910. No. 16282.

Agricultural Machinery.

See also Tactics, under AUTOMOBILES.

Calculating Machines.

The Ellis Adding Typewriter. Ralph E. Flanders. Illustrates and describes the principle of the adding and mechanism and its application to a new type of machine. 7000 w. Mach, N Y—Aug., 1910. No. 16102 C.

Clocks.

Two Remarkable Old English Clocks. F. A. Halsey. Illustrated description of timepieces 600 years old, one of which is still at work. 900 w. Am Mach—Vol. 33. No. 33. No. 16420.

Guns.

Vickers' Ordnance at the Japan-British Exhibition. Plates, illustrations and description of the exhibits. 4500 w. Engng—Aug. 12, 1910. No. 16600 A.

MINING AND METALLURGY.

COAL AND COKE.

Accidents.

Coal-Cutting Machinery and Electrical Accidents in Mines. Information from the report of H. M. Inspectors of Mines for the year 1909, showing progress in use of electrically-driven machinery, the accidents and precautions necessary. 1500 w. Elec Rev, Lond—Aug. 5, 1910. Serial. 1st part. No. 16341 A.

Alaska.

The Bering River Coalfield of Alaska. L. W. Storm. Map and description of this field, the quality of the coal, and discusses the importance of its development. 2700 w. Eng & Min Jour—Aug. 6, 1910. No. 16212.

Alberta.

The Galt Coalfield, Alberta. W. D. L. Hardie. Brief description. 1000 w. Ir &

Coal Trds Rev—Aug. 12, 1910. No. 16608 A.

Briquetting.

The Manufacture of Coal Briquettes. A. R. Maujer. Illustrates and describes the equipment of a plant for manufacturing briquettes from anthracite dust. 1000 w. Power—Aug. 23, 1910. No. 16467.

Coke Ovens.

The Collin Regenerator By-Product Coke Oven. Illustrated description of a successful German type recently introduced in the United States. 1500 w. Ir Age—Aug. 4, 1910. No. 16158.

The Koppers By-Product Coke Oven and Direct Ammonia Recovery Process. Illustrates and describes a modern process for lowering the cost and reducing time of production. Plate. 2000 w. Ir Trd Rev—Aug. 11, 1910. No. 16304.

Coking.

The Tendencies of Modern Coking Practice. Ernest Bury. Discusses the by-product coking industry, comparing processes. 5000 w. Col Guard—Aug. 5, 1910. No. 16351 A.

Coking By-Products.

By-Product Ovens in America and Europe. F. E. Lucas. A comparison of practice at plants operated in connection with iron and steel works. 1500 w. Ir Age—Aug. 18, 1910. No. 16434.

Progress in the Recovery of Coking By-Products (Ueber die Fortschritte in der Gewinnung der Nebenprodukte beim Kokereibetriebe). O. Rau. Read at the Düsseldorf Congress. A review of the development of by-product coking in Europe. Serial. 1st part. 10000 w. Stahl u Eisen—July 20, 1910. No. 16580 D.

Electric Power.

Earthed and Insulated Neutrals in Colliery Work. Abstract of a paper by W. Wellesley Wood before the British Inst. of Elec. Engrs., discussing the principal advantages of the respective systems. 1000 w. Eng & Min Jour—Aug. 6, 1910. No. 16213.

England.

Re-Survey of the Derbyshire and Nottinghamshire Coalfield. Information from the last report of the Progress of the Geological Survey of Great Britain, relating to the coal measures. 2000 w. Ir & Coal Trds Rev—Aug. 19, 1910. No. 16727 A.

Explosions.

Some Simple Experiments to Illustrate the Propagation of Explosions in Non-Detonating Explosive Gaseous Mixtures. G. R. Thompson. Read before the Midland Inst. of Min., Civ. and Mech. Engrs. Describes recent investigations. 2800 w. Ir & Coal Trds Rev—Aug. 5, 1910. No. 16363 A.

The Mulga Mine Explosion. Explains conditions and probable cause of an explosion in Alabama. Ills. 1500 w. Mines & Min—Aug., 1910. No. 16096 C.

Explosives.

Gaseous Decomposition-Products of Black Powder, with Special Reference to the Use of Black Powder in Coal-Mines. Clinton M. Young. Describes experiments carried on in 1908-9 by the State Geological Survey of Kansas. 7500 w. Bul Am Inst of Min Engrs—Aug., 1910. No. 16410 F.

Germany.

The Future of the German Coal Industry. Discusses the question of the Coal Syndicate, and present conditions. 2000 w. Ir & Coal Trds Rev—Aug. 19, 1910. No. 16725 A.

Illinois.

The Illinois Coal Field. H. H. Stoek. Reviews the history and discusses the geology, trade, inspection, and mining districts. Map. 4000 w. Mines & Min—Aug., 1910. No. 16097 C.

Mine Accounting.

Colliery Book-Keeping and Accounts. George Johnson. Detailed explanation of methods used. 2500 w. Ir & Coal Trds Rev—Aug. 5, 1910. Serial. 1st part. No. 16364 A.

Mine Air.

Variations of Atmospheric Pressure and the Methane Content of Pit Air. Abstract translation from *Zeit. fur das Berg-, Hutten- und Salinenwean.* Report of experimental investigations. 1000 w. Compressed Air—Aug., 1910. No. 16403.

Mine Dust.

Coal Dust Experiments at the Experimental Gallery of the Rossitz Coalfield. Dr. Czaplinski and J. Jicinsky. Trans. from *Oesterreichische Zeit. fur Berg- und Hüttenwesen.* Experimental study of the explosibility. 1700 w. Ir & Coal Trds Rev—July 22, 1910. No. 16155 A.

Mine Fires

Recollections of Mine Fires. William Crosley. Recollections of the Pemberton colliery explosion in 1877, and the Abbontiakoon mine in 1905. 2000 w. Mining Mag—Aug., 1910. No. 16639 B.

Mine Gas.

The Cunynghame-Cadman Firemen's Lamp. Illustrated description of a lamp for testing the safety of a mine atmosphere. 1000 w. Engng—July 22, 1910. No. 16145 A.

Mining Plants.

Engineering of Modern Coal Plants. Howard N. Eavenson. Read before the W. Va. Min. Inst. Describes the plants of the United States Coal & Coke Co. 4500 w. Mines & Min—Aug., 1910. No. 16098 C.

A Model Coal Mining Plant in Wyoming. Henry M. Payne. Illustrated description of the equipment and methods of the Superior Coal Co. 1500 w. Eng & Min Jour—July 30, 1910. No. 16068.

Peat.

The Exploitation of the Peat Bogs of

Canada. Eugene Haanel. An address at Ottawa on the development of the extensive peat deposits. 3000 w. Prac Engr—Aug. 19, 1910. No. 16694 A.

Refuge Chambers.

Refuge Chambers in Coal Mines. George S. Rice. Reviews the Cherry disaster and discusses the construction of refuge chambers and the cost. Ills. 4000 w. Eng & Min Jour—Aug. 27, 1910. No. 16677.

The Employment of Mine Refuge Chambers (Emploi des Chambres de Sureté dans les Mines). Ch. Marquet. Discusses their disposition, construction and arrangement, and use. Ills. 2400 w. Mem Soc Ing Civ de France—May, 1910. No. 16504 G.

Rescue Stations.

New Rescue Station in South Wales. Illustrations and brief description of the new station at Crumlin, recently opened. 300 w. Col Guard—Aug. 12, 1910. No. 16499 A.

Tipples.

Modern Methods in a Coal Tipple. Henry Harrison. Illustrates and describes the Empire Tipple in W. Va., and the methods of treatment. 3000 w. Eng & Min Jour—Aug. 20, 1910. No. 16466.

Wales.

The Eastern Development of the North Wales Coalfield. Sketch plan and description of the extension, with report of uncompleted work. 1500 w. Col Guard—Aug. 5, 1910. No. 16352 A.

COPPER.

Australia.

Notes on the Geology of Mount Morgan, Queensland. J. M. Newman and G. F. Campbell Brown. Read before the Aust. Inst. of Min. Engrs. Ills. 4000 w. Queens Gov Min Jour—July 15, 1910. No. 16730 B.

Blast Furnaces.

Circular Copper Blast Furnaces. Thomas E. Lambert. Illustrated comparison of forms of furnaces used for smelting iron and copper ores. 4000 w. Mines & Min—Aug., 1910. No. 16094 C.

Converter Lining.

Basic Lined Converters for Leady Copper Matter. Radick R. Moore. Reports basic linings successful under careful operation. 2000 w. Eng & Min Jour—Aug. 6, 1910. No. 16209.

Mexico.

Ore Deposits of Cananea Mining District, Mexico. S. F. Emmons. Describes three types of ore deposits and gives information concerning the geology, the production, etc. Map. 2000 w. Eng & Min Jour—Aug. 27, 1910. No. 16672.

Minnesota.

Keweenowan Copper Deposits. Frank F. Grout. A study of the source of the copper. 2000 w. Ec-Geol—July-Aug., 1910. No. 16294 D.

Newfoundland.

The Mineral Resources of Newfoundland. Breaton Symons. Describes the general geology, reporting deposits of copper, hematite, and pyrite, the development, and information relating to mining. Map. 3500 w. Eng & Min Jour—Aug. 20, 1910. No. 16464.

New Mexico.

The Chino Copper Property, New Mexico. C. A. Dinsmore. Illustrates and describes the work in progress at these copper mines. 2000 w. Min Wld—Aug. 27, 1910. No. 16683.

Quebec.

Early Copper Mining in the Province of Quebec. James Douglas. An interesting review of the history of its development. 5000 w. Can Min Jour—Aug. 1, 1910. No. 16077.

Smelter Fumes.

The Condensation of Fume and the Neutralization of Furnace-Gases. F. T. Havard. Reviews the history of the condensation of fume, describing methods used in condensing fume and in de-acidifying furnace-gases. 6000 w. Bul Am Inst of Min Engrs—Aug., 1910. No. 16407 F.

Smelting.

Mining and Smelting Plant of Mond Nickel Co. Grant B. Shipley. Illustrated description of a reconstructed copper-nickel plant using electric power. 3000 w. Eng & Min Jour—Aug. 20, 1910. No. 16465.

The Yampa Smelter at Bingham. Leroy A. Palmer. Describes the process by which low grade copper ore is smelted. Ills. 6000 w. Mines & Min—Aug., 1910. No. 16093 C.

GOLD AND SILVER.

Alaska.

Placer Mining Operations in Alaska in 1909. Alfred H. Brooks. Information concerning the last year's work, the production, etc. Maps. 3000 w. Eng & Min Jour—Aug. 27, 1910. No. 16675.

Assaying.

Labor-Saving Appliances in the Assay-Laboratory. Edward Keller. Supplementary to the earlier paper. Illustrates and describes devices for working in sets. 600 w. Bul Am Inst of Min Engrs—Aug., 1910. No. 16409 F.

Australia.

Dredge Mining and Hydraulic Sluicing in 1909. D. B. Sellars. A review of the plants in New South Wales. 2000 w. Aust Min Stand—June 22, 1910. No. 16122 B.

The Deserted Reefs of Castlemaine (V.). Reviews the history and describes the district. 3500 w. Aust Min Stand—July 20, 1910. No. 16728 B.

Notes on the Great Fitzroy Mines, Limited. J. Adam. Read before the Aust. Inst. of Min. Engrs. Describes deposits worked for gold and silver, the geology, workings, sampling, etc. 1800 w. Queens Gov Min Jour—July 15, 1910. No. 16731 B.

Chlorination.

Electrolytic Chlorine at Mt. Morgan, Queensland. B. Du Faur. Illustrated detailed description of this plant and its operation. 3500 w. Aust Min Stand—June 22, 1910. No. 16120 B.

Cobalt.

See also Hydro-Electric, under ELECTRICAL ENGINEERING, GENERATING STATIONS

Cyaniding.

The Destruction of Cyanide. James Moir and Jas. Gray. An account of experiments which contradict practically everything that is to be found in the text-books on the ferro-cyanide reaction. Also a criticism and report of experiments by H. A. White. 10800 w. Jour Chem, Met & Min Soc of S Africa—June, 1910. No. 16485 E.

Notes on the Cyanidation of Concentrates. Herbert A. Megraw. Brief discussion of various methods of treatment. 2200 w. Min Wld—Aug. 13, 1910. No. 16368.

Cyaniding at the North Star Mines in California. John Tyssowski. Describes the cyaniding of mill tailings and concentration, claiming high extraction. Ills. 2500 w. Eng & Min Jour—Aug. 27, 1910. No. 16674.

Continuous Agitation System at Esperanza. M. H. Kuryla. Describes the present continuous system at El Oro, Mexico, and the equipment. 800 w. Eng & Min Jour—July 30, 1910. No. 16065.

Reconstruction of the Angustias Cyanide Mill. Herbert A. Megraw. Illustrates and describes a plant in Mexico. The mill was built for the patio process. A 50-ton cyanide plant has been installed. 2000 w. Eng & Min Jour—Aug. 13, 1910. No. 16333.

Dredging.

Gold Dredging Operations in Montana. J. P. Rowe. Describes the various properties being worked, illustrating the dredges used. 3000 w. Min Wld—Aug. 27, 1910. No. 16682.

Germany.

The St. Andreasberg Silver Deposits (Die Silbererzgänge von St. Andreasberg i. H.). Herr Werner. Read at the Düsseldorf Congress. Illustrated description of these German deposits. Serial. 1st part. 5500 w. Glückauf—July 16, 1910. No. 16589 D.

Korea.

Gold Mining in Korea, 1910. J. D. Hubbard. Brief review of the work of various companies. Ills. 2500 w. Min & Sci Pr—Aug. 20, 1910. No. 16648.

Mexico.

Conditions at the Palmilla Mine, Parral, Mexico. Franklin W. Smith. Reviews the history of the property, describing the ore deposits and their development. Ills. 3000 w. Eng & Min Jour—Aug. 6, 1910. No. 16208.

Montana.

East Coeur d'Alene Mining District, Montana. Harry A. Moore. An illustrated account of this district and its development, describing the mining properties and the copper, lead, silver, and gold zones. 4500 w. Min Wld—Aug. 13, 1910. No. 16370.

Ontario.

Geology of the Porcupine Gold Fields Defined. Alex. Gray. Describes the topography and geology, the important rocks, ore bodies, etc., of this Ontario region. Map. 4500 w. Min Wld—Aug. 13, 1910. No. 16369.

The Gold District of Wabigoon Lake, Ontario. R. B. Brinsmade. Illustrated account of the geology and development of mining properties. 2000 w. Min Wld—Aug. 6, 1910. No. 16223.

Precipitation.

Experiments on the Precipitation of Gold from Cyanide Solution by Carbon in Lime. Edward H. Croghan. A report of experimental investigations. 2000 w. Jour Chem, Met, & Min Soc of S Africa—May, 1910. No. 16119 E.

Rand.

Possibilities of Deep Mining in the Transvaal. Rowland Gascoyne. Discusses the possibilities and the difficulties. 2500 w. Min Wld—Aug. 20, 1910. No. 16456.

Rand Mine Returns, with Special Reference to the New Fathomage System. W. W. Mein. Explains and defends established tonnage methods and criticizes the proposed reform. 11000 w. Jour S African Assn of Engrs—May-June, 1910. No. 16336 F.

IRON AND STEEL.

Bessemer Process.

An Experimental Analysis of the Basic Bessemer Process (Analyse expérimentale du Procédé Thomas). Marius Picard. A discussion based on the researches of Wüst and Laval, reported in Stahl u Eisen for Jan. 27, 1909. Ills. Serial. 1st part. 5000 w. Tech Mod—July, 1910. No. 16529 D.

Blast Furnace Charging.

The Mechanical Charging of Blast Furnaces. Edgar J. W. Richards and Thomas Lewis. Read before the Cleveland Inst. of Engrs. Abstract. Discusses types of chargers, particularly the inventions of the authors. Ills. 3500 w. Ir & Coal Trds Rev—Aug. 5, 1910. No. 16362 A.

Blast-Furnace Gas.

Boiler Firing with Blast-Furnace Gas and an Automatic Gas-Burning Apparatus (Ueber Versuche rationeller Hochofen-Kesselheizung und Beschreibung eines automatisch wirkenden Gasbrennapparates bei der Hüttenindustrie). Gustav Oelwein. Describes the equipment of a plant at Trynietz, Austria. Ills. Serial. 1st part. 3000 w. Oest Zeitschr f Berg- u Hüttenwesen—July 9, 1910. No. 16586 D.

Blast-Furnace Practice.

Agglomeration of Manganiferous Limonite Ore. F. Witte. Abridged translation from *Stahl u. Eisen.* Describes the ores and the treatment. 1500 w. Eng & Min Jour—July 30, 1910. No. 16066.

Blowers.

The Economy of Various Working Methods of Driving Blowing Engines in Steel Works. Herr Mauritz. Abstract of a paper read before the Int. Cong. at Dusseldorf. Shows that blast furnace gas is capable of supplying all requirements for power, and have still some power left in reserve. 3000 w. Ir & Coal Trds Rev—July 22, 1910. No. 16153 A.

Brazil.

Brazil's Iron-Ore Deposits. Reports large amounts of high-grade ores as yet undeveloped, awaiting means of transportation. 3500 w. Mines & Min—Aug., 1910. No. 16091 C.

California.

Future Pig-Iron Production in California. A. H. Martin. Discusses the prospect for the development of important iron mining and smelting districts. 2000 w. Min Wld—Aug. 27, 1910. No. 16684.

Case Hardening.

See same title, under MECHANICAL ENGINEERING, MACHINE WORKS AND FOUNDRIES.

Electro-Metallurgy.

Electric Smelting of Iron Ore at Heroult, Cal. John Tyssowski. Illustrates and describes this electric iron-smelting plant. 3000 w. Eng & Min Jour—Aug. 6, 1910. No. 16211.

France.

The Iron-Ore Resources of France (Les Ressources de la France en Minerals de Fer). From the "Iron Ore Resources of the World," a report compiled by the Bureau of the Eleventh International Congress of Geology. Ills. 4000 w. Génie Civil—July 2, 1910. No. 16545 D.

Hot-Blast Stoves.

The Design and Heating Power of Hot-Blast Stoves (Berechnung und Wärmeausstrahlung steinerner Winderhitzer). Chr. Aldendorff. A criticism of Osann's paper in *Stahl und Eisen* for July 14, 1909, *et seq.* Ills. 4500 w. Stahl u Eisen—July 27, 1910. No. 16582 D.

New Brunswick.

Bathurst District, New Brunswick. G. A. Young. Abstract from the summary report of the Geological Survey, describing this district. Map. 4500 w. Can Min Jour—Aug. 15, 1910. No. 16451.

Newfoundland.

See same title, under COPPER.

New York.

The Eastern Pig Iron Association at Port Henry. Report of a visit to Witherbee, Sherman & Co.'s properties in the eastern Adirondack district, describing important new mining and concentrating operations. 5000 w. Ir Age—Aug. 4, 1910. No. 16157.

Open-Hearth Furnaces.

Open Hearth Furnace Construction. O. Friedrich. Abstract translation of paper read at the Dusseldorf Cong. Illustrates and describes improvements in recent years as developed by German engineers. 1500 w. Ir Age—Aug. 25, 1910. No. 16624.

Ore Resources.

The Iron Ore Resources of the World. Reviews a recent work published in Sweden which shows the available supply to be sufficient for 200 years at the present rate of consumption. 2000 w. Ir Age—Aug. 11, 1910. No. 16268.

Rolling Mills.

The Rolling of Iron and Steel. Oscar C. Morgan. Abstract of paper read before the Nottingham Guild of Mech. & Elec. Engrs. Considers the nature of the action of rolls, and the effect on the piece under operation, effect on the rolls, effect of temperature, and matters related. 5500 w. Ir & Coal Trds Rev—July 29, 1910. No. 16258 A.

Improvements in Rolling Mill Construction. H. Ortmann. Abstract of paper read before the Int. Cong. at Dusseldorf. Review of changes introduced during the last ten years. 2000 w. Ir & Coal Trds Rev—Aug. 12, 1910. No. 16607 A.

Improvements in Electric Driving and Control for Rolling Mills. H. Ortmann. From a paper read before the Int. Cong. at Dusseldorf. Illustrates and describes recent arrangements for electric rolling-mill drives. 1500 w. Ir & Coal Trds Rev—Aug. 5, 1910. No. 16366 A.

Features of Construction and Operation of the Three-High Universal Plate Mill. B. H. Reddy. Discusses the advantages of the universal mill and some of the problems to be considered in the design of the modern mill. Ills. 3500 w. Ir Trd Rev—Aug. 18, 1910. No. 16437.

The Gary Car Axle Mill. Illustrated description of the Indiana Steel Company's axle plant. 2500 w. Ir Age—Aug. 18, 1910. No. 16435.

The Rolling of Sheets and Tin Plate (Das Walzen von Fein- und Weissblechen). W. Krämer. Discusses English and German competition and describes a typical plate mill. Ills. 5000 w. Stahl u Eisen—July 6, 1910. No. 16575 D.

An Investigation of the Power Requirements of Rolling Mills (Essais sur la Détermination de la Dépense d'Energie des Laminoirs). J. Puppe. An abstract translation of a paper before the Verein

Deutscher Eisenhüttenleute. Ills. 5000 w. Rev de Métal—July, 1910. No. 16518 E + F.

Steel Works.

The Cambria Steel Works. An illustrated article describing the main features of these works, its products, organization, and other matters of interest. 5000 w. Ry Age Gaz—Aug. 19, 1910. No. 16462.

The Rasselstein Steel Works (Eisenwerk Rasselstein). Describes the recent developments in the oldest steel works in Germany. Ills. 3000 w. Stahl u Eisen—July 6, 1910. No. 16574 D.

Tin Plate.

The Production of Tin Plate (Ueber Weissblecherzeugung). B. v. Clement. Describes, and compares with German, English practice and product. Ills. 9500 w. Stahl u Eisen—July 6, 1910. No. 16576 D.

See also Rolling Mills, under IRON AND STEEL.

LEAD AND ZINC.

Arkansas.

Zinc and Lead in Arkansas. Lucius L. Wittich. Reports the change from tunnel to shaft mining in developing a new region, in order to reach deeper deposits. 2000 w. Mines & Min—Aug., 1910. No. 16092 C.

Australia.

Geology of the Broken Hill Lode. Information from the Interim Report of the Geological Committee. 5000 w. Aust Min Stand—June 22, 1910. No. 16121 B.

Lead Desilverizing.

Parke's Process for Desilverizing Lead. John K. Archer. Describes the Parke process in operation at the Port Pirie (S. Aust.) works of the Broken Hill Proprietary Co. 1500 w. Aust Min Stand—July 27, 1910. No. 16746 B.

Zinc Smelting.

Fume Filtration for Production of Pure Spelter. John S. G. Primrose. Describes the process as carried out at Irvine, Scotland. Ills. 3000 w. Eng & Min Jour—Aug. 27, 1910. No. 16676.

Smelting Briquetted Zinc Ore. Theodore J. Hoover. Reports a zinc-smelting test made on mixed concentrates by the briquetting process. 1500 w. Eng & Min Jour—Aug. 13, 1910. No. 16334.

MINOR MINERALS.

Aluminium.

The Aluminium Works at Kinlochleven. Abstract of a paper by A. Alban H. Scott, read before the Concrete Inst., describing the works of the British Aluminium Co. 1800 w. Engr, Lond—July 22, 1910. No. 16152 A.

Asbestos.

On the Distribution of Asbestos Deposits in the Eastern Townships of Quebec. John A. Dresser. Shows some of the geological relations of the serpentine belt and how they determine the distribution of the mineral deposits. 4500 w. Can Min Jour—Aug. 1, 1910. No. 16079.

Clays.

The Clay and Shale Deposits of Nova Scotia and Portions of New Brunswick and Prince Edward Island. Heinrich Ries. A study to ascertain what deposits are adapted to the manufacture of clay products. 1200 w. Can Min Jour—Aug. 1, 1910. Serial. 1st part. No. 16080.

Diamonds.

Diamond Mines of Arkansas John L. Cowan. Information concerning their discovery and probable value. Ills. 2000 w. Min & Sci Pr—Aug. 6, 1910. No. 16303.

Mica.

Mica in the Black Hills of South Dakota. Jesse Simmons. A report of the different districts and present condition of the industry. 2500 w. Min Wld—Aug. 6, 1910. No. 16224.

Molybdenite.

The Occurrences of Molybdenite in Arizona. F. Schrader and J. M. Hill. Describes the deposits, their localities and development, and discusses their origin. Map. 3500 w. Min Wld—July 30, 1910. No. 16075.

Nickel.

See Smelting, under COPPER.

Oil.

Oil Shale Deposits, Blue Mountains, N. S. W. H. L. Jene. Describes shale in Australia similar to the Scotland deposits, and the system of working. 1500 w Eng & Min Jour—Aug 27, 1910. No. 16673.

Some Notes on the History of Petroleum. Gordon Surr. Interesting information concerning the earliest known uses. 1800 w. Min Wld—Aug. 13, 1910. No. 16371.

Conditions Favorable for Petroleum Prospecting. Gordon Surr. Calls attention to geological and surface indications favorable for accumulation of petroleum. 1500 w. Min Wld—Aug. 6, 1910. No. 16225.

Geology of the Coalinga Oil Field. Illustrates and describes the distinguishing rocks and fossils of this California oil-field. 2000 w. Mines & Min—Aug, 1910. No. 16090 C.

Acquisition of Public Oil Lands. William Forstner. Discusses the law and regulations formerly affecting these lands, and the new law recently passed. 2000 w. Min & Sci Pr—Aug. 6, 1910. No. 16301.

Determination of the Source of a Naphtha or of Its Derivatives (Determination de la Provenance d'un Naphte ou de ses Dérivés). N. Chercheffsky. Gives data based on numerous analyses by which the country of origin of petroleum products may be determined. 2500 w. Bul Soc d' Encour—June, 1910. No. 16520 G.

Platinum.

Original Occurrences of Platinum in the Urals. E. de Hautpick. Reports investigations carried out to discover new original sources of platinum. 1500 w. Min Jour—July 30, 1910. Serial. 1st part. No. 16243 A

Slate.

Peach Bottom Slate Deposits, Pennsylvania. Edw. G. W. Ferguson. Describes these deposits. Ills. 1200 w. Min Wld—July 30, 1910. No. 16074

Tin.

Mount Bischoff Tin Mine, Tasmania. J. D. Millen. Map and illustrated description of this property and its development. 1800 w. Min Jour—Aug 6, 1910 Serial. 1st part. No. 16343 A

Titanium.

New Rutile Deposits Near Richmond, Va. Frank H. Hess. Describes deposits of this titaniferous mineral. Ills. 1500 w. Min Wld—Aug. 20, 1910. No. 16455.

MINING.

Accidents.

Mining Accidents. T. Good. A review of present conditions in Great Britain. 2200 w. Cassier's Mag—Aug., 1910. No. 16293 B.

See also same title, under Coal and Coke.

Accounting.

Cost Distribution at the Montezuma Mines. S. F. Shaw. Describes the system of accounting adopted at these Costa Rica Mines. 1500 w. Min Wld—Sept. 3, 1910. No. 16926.

See also Mine Accounting, under Coal and Coke.

Drills.

Pneumatic, Hydraulic, and Electric Drills (Perforatrices à Commande pneumatique, hydraulique, ou électrique). F. Hofer. A brief review of the leading types. Ills. 5000 w. Génie Civil—July 9, 1910. No. 16546 D.

Drill Sharpening.

Sharpening Miner's Tools. Matt W. Alderson. Suggestions and remarks. 1500 w. Min Wld—Aug. 6, 1910. No. 16227.

Explosives.

Explosives. F. H. Gunsolus. Brief review of advances made in the manufacture, handling, storage and use of explosives since 1886. 2500 w. Jour Fr Inst—Aug., 1910. No. 16379 D.

See also same title, under Coal and Coke.

Finance.

Methods of Promoting or Financing a Mine. Francis C. Nicholas. Critical discussion of different plans and methods. 4000 w. Min Wld—Aug. 20, 1910. No. 16457.

Hoisting Engines.

Overwinding and Overspeed Controller for Winding Engines. Illustrated description of Wilde and Petrie's gear. 1000 w. Col Guard—Aug. 19, 1910. No. 16712 A.

The Control of Hoisting Engines, Rolling Mills, and Three-Phase Generating Stations (Die Lenkung von Fördermaschinen, Walzwerkantrieben und Drehstromzentralen). H. Hoffmann. Read at the Düsseldorf Congress. Advocates control by means of devices independent of the load. Ills. 4000 w. Glückauf—July 9, 1910. No. 16588 D.

Methods.

Top-Slicing Mining Methods at Cananea, Mexico. Courtenay De Kalb. Describes an adaptation of top-slicing in the Oversight mine. Ills. 800 w. Min & Sci Pr—Aug. 20, 1910. No. 16647.

Mine Locomotives.

Gasoline Mine Locomotives. Illustrated descriptions of gasoline locomotives successfully used in Germany for mine haulage. 2000 w. Mines & Min—Aug., 1910. No. 16095 C.

Plants.

Design of a Mine Plant. J. W. Whitehurst and W. P. Cary. Student's prize paper. An illustrated study. 2200 w. Min & Sci Pr—Aug. 13, 1910. Serial. 1st part. No. 16438.

Prospecting.

See Oil, under Minor Minerals.

Pumping.

Recent Developments in Pumping Equipment (Neuerungen auf dem Gebiete der Wasserhaltung). Herr Schultze. Read at the Düsseldorf Congress. Describes a number of German installations. Ills. 5500 w. Glückauf—July 16, 1910. No. 16590 D.

Quarrying.

The Kentish Ragstone Quarries. P. Walton Harrison. Illustrates and describes the methods of quarrying, the cost and uses of materials. 1800 w. Surveyor—Aug. 12, 1910. No. 16494 A.

The Scottish Granite Industry. William Diack. Illustrated description of granite quarrying and working in Aberdeenshire. 3000 w. Cassier's Mag—Aug., 1910. No. 16288 B.

Shaft Sinking.

Shaft Sinking and Power Production at the Hattorf Potash Mines (Das Schachtabteufen und die Krafterzeugungsanlagen der Kaliwerke Hattorf). E. Koch. Describes the deepening of the shaft and the surface plant. Ills. 3200 w. Glückauf—July 23, 1910. No. 16591 D.

Stowing.

Sand-Filling on the Witwatersrand. Edgar Pam. Describes methods used, stating advantages. General discussion. Ills. 3000 w. Jour Chem., Met., & Min Soc of S. Africa—June, 1910. No. 16484 E.

Timber Flume.

Water Flume Conveyors at Mount Lyell. E. Carus Driffield Abridged paper read at Aust. Inst. of Min. Engrs. Illustrated description of method of transporting fire-wood, explaining conditions. 4000 w. Queens Gov Min Jour—July 15, 1910. No. 16729 B.

ORE DRESSING AND CONCENTRATION.

Briquetting.

See also Blast-Furnace Practice, under Iron and Steel.

Copper.

Miami Concentrating Mill. R. L. Herrick. Illustrates and describes features of construction that tend to economy. 2500 w. Mines & Min—Aug., 1910. No. 16089 C.

Crushing.

Some of the Mathematical Laws of Crushing. A. W. Warwick. Reviews briefly investigations made and laws laid down, criticising some of the statements, and the work of the Mines Trials Committee of S. Africa. 4000 w. Min Wld—July 30, 1910. No. 16073.

See also Screen Analyses, under Ore Dressing and Concentration.

Recovery.

Calculations of Percentage of Recovery. Theodore J. Hoover. Considers methods of calculation in concentration operations. 1500 w. Mining Mag—Aug., 1910. No. 16637 B.

Screen Analyses.

Grading Analyses and Their Application. H. Stadler. Shows how the varying proportions of certain standard sizes of particles may be valued in units of energy, which will allow of an exact expresson of the efficiency of the crushing operation for comparison. 5000 w. Jour Chem, Met, & Min Soc of S Africa—May, 1910. No. 16118 E.

Slimes Treatment.

The Chemical Control of Slimes. Harrison Everett Ashley. Aims to show that certain chemical considerations may greatly hinder or assist the successful operation of mechanical processes used. Ills. 3000 w. Bul Am Inst of Min Engrs—Aug., 1910. No. 16408 F.

Concentration of Slime. Edwin A. Sperry. Discusses the subject under the heads of crushing and grinding, sizing, classification, dewatering, and final treatment. 3500 w. Min & Sci Pr—Aug. 6, 1910. Serial. 1st part. No. 16302.

Slime Treatment at the Santa Natalia Mill. Cooper Shapeley. Plan and detailed description of the equipment and process. 1200 w. Eng & Min Jour—Aug. 20, 1910. No. 16463.

Tailings Disposal.

The Calumet & Hecla Sand Wheels. C. L. C. Fichtel. Illustrated description of a tailings wheel and its operation. 800 w. Eng & Min Jour—July 30, 1910. No. 16067.

Water Supply.

Tailing Dams and Conservation of Mill Water. W. H. Storms. Describes methods used when water is scarce to recover mill water for repeated use. Ills. 2200 w. Eng & Min Jour—Aug. 6, 1910. No. 16210.

MISCELLANY.

Australia.

Queensland Mines Inspection C. F. V. Jackson. Extracts from the chief inspector's report for 1909 in regard to labor, wages, accidents, ventilation, etc. Ills. 8500 w. Queens Gov Min Jour—June 15, 1910. No. 16123 B.

British Columbia.

Mineral Production of British Columbia in 1909. Information from the Annual Report of the Minister of Mines. 2500 w. Can Min Jour—Aug. 1, 1910. No. 16078.

Dusseldorf Congress.

The International Congress, Düsseldorf, 1910 (Der Internationale Kongress Düsseldorf 1910). A detailed report of the proceedings. Serial. 1st part. 7200 w. Glückauf—July 23, 1910. No. 16592 D.

Geology.

Nature of the Earth's Interior. Prof. E. H. L. Schwarz. Discusses its relation to the question of deep mining. 3500 w. Sci Am Sup—Aug. 13, 1910. No. 16285.

Government Bounties.

State Assistance to Mining. C. F. V. Jackson. Abstract of a paper read before the Mount Morgan meeting of the Aust. Inst. of Min. Engrs. Describes briefly the practice, methods, expenditure and some results. 3500 w. Aust Min Stand—July 6, 1910. No. 16416 B.

Nicaragua.

Mining in Nicaragua. T. Lane Carter. Explanation of conditions, reviewing briefly the history of mining in this region. Ills. 3500 w. Mining Mag—Aug., 1910. No. 16638 B.

Ore Deposits.

A Replacement of Rhyolite Porphyry by Stephanite and Chalcopyrite at Leadville. Clarence N. Fenner. Describes an interesting form of metasomatic replacement. Ills. 1000 w. Sch of Mines Qr—April, 1910. No. 16478 D.

The Importance of the Porphyry Coppers. Charles R. Keyes. Discusses ore deposits of the arid regions and the effect of physical conditions and related matters. 1500 w. Min Wld—Aug. 6, 1910. No. 16226.

Refractory Materials.

Analyses of Rhine Clays, with Special Reference to Their Content of Fluxing Materials (Ueber Analysen rheinischer Tone mit besonderer Berücksichtigung der Flussmittel). Dr. Fuchs. A consideration of the relation between fluxing materials and alumina in the West-Germany fireclays. 2000 w. Stahl u Eisen—July 20, 1910. No. 16581 D.

Washington.

Operations in the Covada District, Washington. Brief report of mines yielding gold, silver, copper, lead, zinc and antimony. 1500 w. Min Wld—Aug. 27, 1910. No. 16685.

RAILWAY ENGINEERING.

CONDUCTING TRANSPORTATION.

Signalling.

An Improvement to the Aubine Signal Apparatus (Sur un Dispositif additionnel permettant l'Emploi de l'Appareil Aubine pour la Fermeture automatique des Signaux de Chemins de Fer carrés et Munis de Pétardo). Léon Lejeune. Describes an improved arrangement devised by the author. Ills. 1500 w. L'Elecn—July 9, 1910. No. 16540 D.

Train Despatching.

The Duties of the Chief Despatcher. A discussion of the duties and the difficulties. 2500 w. Ry Age Gaz—Aug. 12, 1910. No. 16321.

MOTIVE POWER AND EQUIPMENT.

Air Brakes.

Brakes Creeping On. Explanatory comments. 2000 w. Ry & Loc Engng—Aug., 1910. No. 16101 C.

The Passenger Control Equipment. Illustrated description of the Westinghouse general arrangement. 1500 w. Ry & Loc Engng—Aug., 1910. No. 16100 C.

Couplings.

International Competition on Automatic Couplings for Railway Cars (Concorso Internazionale per l'Agganciamento automatico dei Vagoni ferroviari). A report of practical tests of the prize-winning devices exhibited at Milan, 1906. Serial. 1st part. 3000 w. Monit Tech—July 10, 1910. No. 16564 D.

Electrification.

Electric Power for Railroad Operation. Fred. Darlington. Mainly a discussion of the commercial aspects. Ills. 5000 w. Pro Richmond R R Club—March 14, 1910. No. 16389.

Electrification of Suburban Railways. F. W. Carter. Discusses the advantages of electrification of existing steam-operated lines for suburban service in England. 8000 w. Inst of Mech Engrs—July, 1910. No. 16249 N.

The Cost of Electrically-Propelled Suburban Trains. H. M. Hobart. A comparison of systems, showing that the continuous system has decided commercial advantages over the single-phase system for this service. 9000 w. Inst of Mech Engrs—July, 1910. No. 16247 N.

Locomotive Boiler Waters.

Water Softening Plants of the Florida East Coast Railway. A. C. Tomlinson. Illustrates and describes the locomotive water-softening plants, and reports concerning their operation. 2200 w. Eng News—Aug. 11, 1910. No. 16317.

Locomotive Construction.

The Selection of Steel for Locomotive Construction. W. L. Turner. Shows the need of thoroughly testing the qualities imparted by an alloy to steel. 1500 w. Ir & Coal Trds Rev—Aug. 19, 1910. No. 16723 A.

Report No. 5 for All Countries Except America on the Question of the Use of Steel. Ernest Szlabey. The use of steel in the construction of locomotives and rolling stock. Ills. 5000 w. Bul Int Ry Cong—June, 1910. No. 16413 G.

Locomotive Feed Waters.

Corrosive Properties of Boiler Feed Waters. Report by J. G. Scrugham, for the Oregon Short Line R. R. and the So. Pacific Lines east of Sparks, Nev. Covers examination and tests of 110 varieties, and discusses the causes of corrosion and incrustation, and the methods of inhibiting. 3000 w. Ry & Engng Rev—Aug. 27, 1910. No. 16687.

Locomotive Fireboxes.

Improved Firebox with Hollow Arch and Combustion Chamber. F. F. Gaines. Explains mechanical defects in the present form of firebox with combustion chamber and describes improvements. Ills. 1600 w. Ry Age Gaz—Aug. 5, 1910. No. 16192.

Locomotive Headlights.

The Peters Electric Headlight System. Illustrated description of a new headlight for steam locomotives employing a turbo-generator. 1200 w. Ir Age—Aug. 18, 1910. No. 16436.

Locomotive Power.

Characteristic Energy Diagrams for Steam Locomotives. W. E. Dalby. Gives curves from recent test reports and shows how useful they are in comparing engine performances and power. Plate. 5000 w. Engng—Aug. 19, 1910. Serial. 1st part, No. 16713 A.

Locomotive Repairs.

Cylinder Replacement Practice at the Juniata Shops. Ralph E. Flanders. Illustrated description of a method adopted for use in repair shops anywhere. 1000 w. Mach, N Y (Ry Ed)—Aug., 1910. No. 16267 C.

Locomotives.

Mallet Articulated Locomotives, 2-6-8-0 Type. Illustration, with explanation of the principal changes made in the design of new engines for the Great Northern Ry. 1500 w. Am Engr & R R Jour—Aug., 1910. No. 16196 C.

Mikado Locomotive for the Atlanta, Birmingham & Atlantic. Illustration, description and dimensions. 700 w. Ry Age Gaz—Aug. 12, 1910. No. 16322.

Some Details of the Articulated Compound Locomotive Built at the Shops of the Canadian Pacific Railway. Illustrates and describes a number of interesting features. 1500 w. Am Engr & R R Jour—Aug., 1910. No. 16195 C.

Locomotive for the Soudan Government Railways. Plate and illustrated description of a new type of novel design. 300 w. Engr, Lond—July 22, 1910. No. 16150 A.

Locomotives for the Shanghai-Nanking Railway. Illustrated description of four single driven express passenger engines, built in record time. 600 w. Engr, Lond—July 29, 1910. No. 16254 A.

Compound Freight Locomotive with four Coupled Axles and Pilot Truck of the Paris-Lyons-Mediterranean Railway (Locomotive à Marchandises compound à quatre Essieux Couplés et à Bogie avant de la Compagnie Paris-Lyon-Méditerranée). Illustrated description. 2500 w. Génie Civil—July 16, 1910. No. 16549 D.

A French Express Locomotive at the Brussels Exposition. Brief illustrated description of an interesting locomotive to which has been adapted a marine type of water-tube firebox. 1000 w. Ry & Engng Rev—Aug. 27, 1910. No. 16686.

High-Power Locomotives at the Brussels Exhibition. Charles R. King. Illustrates and describes exhibits showing latest European designs. 1200 w. Mach, N Y (Ry Ed)—Aug., 1910. No. 16266 C.

The Locomotives at the Brussels Exhibition (Die Lokomotiven auf der Weltausstellung in Brüssel 1910). Herr Metzeltin. A preliminary report. Ills. 5500 w. Zeitschr d Ver Deutscher Ing—July 9, 1910. No. 16782 D.

Locomotive Speed Gauge.

A Locomotive Speed-Gauge. Alfred Gradenwitz. Illustrated description of a novel electrical speed-gauge based on the voltmeter principle. 1200 w. Sci Am Sup—Aug. 6, 1910. No. 16169.

Locomotive Speeds.

Report No. 2 for All Countries Except America on the Question of Steam Locomotives for Very High Speeds. Mr. Courtin. Gives results of the inquiry concerning locomotives for regulation speeds exceeding 60 miles per hour. Ills. 13000 w. Bul Int Ry Cong—June, 1910. No. 16412 G.

Locomotive Superheaters.

The Application of Superheated Steam to Locomotives (L'Application de la Vapeur surchauffée à l'Exploitation des Locomotives). A detailed description of the Schmidt apparatus and a report of results. Ills. 9500 w. All Indus—July, 1910. No. 16532 D.

Locomotive Valve Gears.

Walschaert Valve Gear. Benjamin Frey. A paper being used as an introduction to a course on the Walschaert valve gear for machinist apprentices on the New York Central lines. 3000 w. Ry Age Gaz—Sept. 2, 1910. No. 16863.

Passenger Cars.

The Paris-Lyons-Mediterranean Railway Carriages at the Brussels Exhibition. Illustrates and describes first-class and composite carriages. 1000 w. Engng—Aug. 5, 1910. No. 16355 A.

Safety Appliances.

Proposed United States Safety-Appliance Standards for the Protection of Employees and Travelers upon Railroads. Gives safety appliance acts passed, and the proposed U. S. safety appliance standards. Ills. 25000 w. Interstate Commerce Commission—1910. No. 16377 N.

Shops.

The Central of Georgia Railway Erecting and Machine Shop. Illustrates and describes new shops at Macon, Georgia. 2500 w. Eng Rec—July 30, 1910. No. 16064.

History of the Schenectady Locomotive Works. Extracts from an article by Hawley B. Van Vechten in "Loco" for May, 1910. A review. 3500 w. Ry & Engng Rev—Aug. 6, 1910. No. 16228.

Sleeping Cars.

Car Construction of the International Sleeping-Car Company from 1872 to 1909 (Note sur le Matériel de la Compagnie internationale des Wagon-lits et des Grands Express Européens construit de 1872 à 1909). A review of the development of sleeping cars in Europe. Ills. 16000 w. Rev Gen d Chemins de Fer—July, 1910. No. 16521 G.

Wrecking Equipment.

See Cranes, under MECHANICAL ENGINEERING, Transporting and Conveying.

NEW PROJECTS.

Italy.

The Splugen Pass Railway (Il Valico Ferroviario dello Spluga). Ugo Ancona. A detailed consideration of the project, from the Italian point of view. Ills. Serial. 1st part. 5000 w. Ing Ferro—July 16, 1910. No. 16571 D.

PERMANENT WAY AND BUILDINGS.

Construction.

Heavy Railway Work Along the Des Chutes River, in Oregon. Describes the topography of the region and the parallel lines of the Des Chutes Ry., and the Oregon Trunk Ry. now being built. Map & Ills. 3000 w. Eng News—Aug. 11, 1910. No. 16309.

Rack Railways.

The Rochette-Asiago Rack Railway (Le Ferrovia a Dentiera Rocchette-Asiago). Giovanni Letter. Detailed description of the line and rolling stock. Ills. 5500 w. Ing Ferro—July 1, 1910. No. 16570 D.

Rail Tests.

Elongation and Ductility Tests of Rail

Sections. P. H. Dudley. Read at Atlantic City meeting of Am. Soc. for Test. Mat. Discusses the results obtained with a new standard drop-testing machine. 3000 w. Ir Trd Rev—Sept. 1, 1910. No. 16858.

Roundhouses.

English Running-Shed Practice. Cecil W. Paget. An illustrated description of the equipment of a running shed, and some features of its management. 5000 w. Inst of Mech Engrs—July, 1910. No. 16246 N.

Terminals.

The Reconstruction of the Passenger Terminals at Washington, D. C. W. F. Strouse. Illustrated detailed description of the design and construction of the new terminal station at Washington. Pro Am Soc of Civ Engrs—Aug., 1910. No. 16641 F.

The Pennsylvania Railroad Improvements About New York. A finely illustrated article describing the tunnel systems and their connections, the New York terminal station building, and the engineering features in the terminal area. 6800 w. Archts & Bldrs' Mag—July, 1910. No. 16044 C.

East Boston Deep-Water Terminal of the Boston & Albany Railroad. Luis G. Morphy. Brief account of the fire that destroyed this terminal in 1908, and illustrated description of the reconstruction and improvements. 6000 w. Jour Assn of Engng Socs—July, 1910. No. 16829 C.

Ties.

See also Timber Preservation, under CIVIL ENGINEERING, MATERIALS OF CONSTRUCTION.

Track Construction.

Record of Gravel Ballasting Using Hopper Bottom Coal Cars on a 75-Mile Haul. D. A. Wallace. A record of efficient work under difficult conditions. 1200 w. Engng-Con—Aug. 3, 1910. No. 16166

New Methods of Studying Track-Laying Problems (Méthodes nouvelles pour l'Etude des Tracés de Voies de Chemins de Fer). P. Le Fort. Describes in detail methods of solving problems of elevation, curvature, super-elevation, etc. Ills. 13200 w. Mem Soc Ing Civ de France—May, 1910. No. 16506 G.

MISCELLANY.

Austria.

Lines of Local Interest and Railway Projects in the Tyrol (Ueber die Lokalbahnverhältnisse und Bahnprojekte in Tirol). J. Riehl. A review of railway development in this part of Austria. 7000 w. Mitt d Ver f d Förd d Lokal- u Strassenbahnwesens—July, 1910. No. 16573 F.

Brazil.

The Rio Grande del Sud Railway (Les Chemins de Fer du Rio Grande du Sud). Lionel Wiener. A description of this Brazilian railway. Ills. 14000 w. Rev Gen d Chemins de Fer—July, 1910. No. 16522 G.

China.

The Imperial Peking-Kalgan Railway and Its Extension. J. L. Dobbins. An illustrated description of an important railway built entirely by the Chinese. 2800 w. Eng News—Aug. 25, 1910. No. 16626.

Germany.

Modern Secondary Railways in Bavaria (Modern betriebene Nebenbahnen in Bayern). Hermann R. v. Littrow. A comparison, technical and economic, with similar railways in Austria. 3000 w. Zeitschr d Oest Ing u Arch Ver—July 1, 1910. No. 16755 D.

Government Control.

Requirements for British Railways. Extracts from an official circular giving the requirements of the British Board of Trade in regard to the opening of railways. 5000 w. Ry & Engng Rev—July 30, 1910. No. 16088.

Ireland.

The Irish Railway Commission. Detailed account of the proceedings and opinions of the Commission appointed to inquire into the system of working on the Irish railways. 2500 w. Engr, Lond—Aug. 5, 1910. Serial. 1st part. No. 16359 A.

Russia.

Transportation and Traffic in Russia. Logan M'Pherson. A preliminary report to the United Waterways Commission. Reviews the development giving facts and statistics obtained officially. 2200 w. Ry Age Gaz—Aug. 5, 1910. No. 16191.

Sierra Leone.

The Sierra Leone Government Railway. Edgar Allen Forbes. Illustrated description of this African system and its operation. 3500 w. Ry Age Gaz—Aug. 26, 1910. No. 16655.

Statistics.

Report No. 4 for North America on the Question of Statistics. A. J. County. Concerning the principles of statistics of railways in operation. 19000 w. Bul Int Ry Cong—June, 1910. No. 16414 G.

Switzerland.

The Construction of Some Mountain Railways in the Canton of Vaud (Notice sur la Construction de quelques Routes de Montagne dans le Canton de Vaud). H. Develey. The first part begins a description of the Aigle-Château-d'Oex line. Ills. Serial. 1st part. 2000 w. Bul Tech d l Suisse Rom—July 25, 1910. No. 16536 D.

Progress on the Bernese Alpine Railway (Etat actuel des Travaux du Chemin de Fer des Alpes Bernoises). Ch. Dantin. Describes the present state of the construction of the line which includes the Lötschberg tunnel. Ills. 5000 w. Génie Civil—July 2, 1910. No. 16544 D.

STREET AND ELECTRIC RAILWAYS.

Berlin.

Berlin's Traffic Problem and the Greater Berlin Competition (Berliner Verkehrsfragen und der Wettbewerb Gross-Berlin). Herr Schimpff. Discusses the need for increased facilities, and a number of designs for extensions submitted in competition. Ills. Serial. 1st part. 4500 w. Elek Kraft u Bahnen—July 14, 1910. No. 16769 D.

Brakes.

Tramway Motor-Car Brakes (Notice sur les Freins des Voitures motrices de Tramways). Marcel Leboucq. Describes particularly the Chaumont system. Ills. 3300 w. Soc Belge d'Elecns—June, 1910. No. 16501 E.

Car Tests.

Car Tests in Philadelphia with Anti-Friction Bearings. Arthur B. Stitzer. Reports a series of tests with anti-friction armature and journal bearings made under regular running conditions for nearly a year. Ills. 1800 w. Elec Ry Jour—Aug. 27, 1910. No. 16649.

Depreciation.

Tramway Depreciation. A. J. J. Pfeiffer. A discussion of the subject from the viewpoint of conditions in Great Britain. 3500 w. Tram & Ry Wld—Aug. 4, 1910. No. 16486 B.

Direct Current.

High-Tension Direct-Current for Electric Railway Traction. Discusses the advantages of this system. 1500 w. Elec Rev, Lond—Aug. 19, 1910. No. 16704 A.

Electric Traction.

Report No. 3 for Austria and Hungary on the Question of Electric Traction. Arthur Hruschka. Discussion of electric traction on large railroads in these countries, the continuous current and alternating current, and comparative cost. Ills. 23800 w. Bul Int Ry Cong—June, 1910. No. 16411 G.

An Investigation of the Safety of Electric Locomotives on Curves (Untersuchungen über das betriebssichere Durchfahren der Kurven mit elektrischen Lokomotiven unter besonderer Berücksichtigung des Einflusses der drehenden Lokomotivmassen). Kurt Wiesinger. Reports an investigation to determine the effect of the moving parts of the locomotive on its safe operation. Ills. 3200 w. Zeitschr f d Gesamte Turbinenwesen—July 2, 1910. No. 16766 D.

Instruction Car.

Instruction Car of the Boston & Northern Street Railway. Illustrated description of the car and its equipment. 3000 w. Elec Ry Jour—Aug. 13, 1910. No. 16319.

Italy.

Electric Traction on the Giovi Railway (La Trazione elettrica sul Valico dei Giovi). Illustrated description of this new three-phase line in Italy. Serial. 1st part. 2500 w. Monit Tech—July 20, 1910. No. 16565 D.

Locomotives.

Electrification of Italian State Railway. Warren H. Miller. Illustrated description of the 3-phase freight locomotives for the Giovo line. 2000 w. Elec Wld—Aug. 11, 1910. No. 16307.

Storage-Battery Locomotive for the Zürich Abbatoir (Akkumulatorenlokomotive des Schlachthofes der Stadt Zürich). H. Studer. Illustrated description. 1500 w. Schweiz Bau—July 2, 1910. No. 16597 B.

Municipal Control.

The Chicago Plan of Street Railway Supervision and Control. Sidney Ossoski. A discussion of the method evolved in the settlement of the traction difficulties in Chicago, which has been in use over three years. 3500 w. Elec Ry Jour—Aug. 6, 1910. No. 16203.

Pittsburgh.

Report on Financial and Operating Records of the Pittsburgh Railways. Gives practically the full text of report submitted by Bion J. Arnold. Also maps, diagrams, and tables. 2500 w. Elec Ry Jour—Aug. 13, 1910. No. 16320.

Pittsburg's Transit Problems: Reports by Bion J. Arnold. A review of reports on the troubles and proposed re-routing of cars and construction of a subway. Editorial note. 4000 w. Eng News—Aug. 4, 1910. No. 16175.

Signalling.

An Automatic Signal for Electric Railways. Carl P. Nachod. Describes a system in which the signals are caused to be displayed by the car or train having passed definite points where contact devices are located. Ills. 4000 w. Pro Engrs' Club of Phila—July, 1910. No. 16396 D.

Subways.

Cars, Schedules, Power Consumption, Running Tests and Signals in London Subways. An illustrated account of operating methods and devices used, reporting tests. 2500 w. Elec Ry Jour—Aug. 6, 1910. No. 16202.

Track Construction.

The Standardizing of Street Railway Track Construction in Paved Streets. B. E. Tilton. Abstract of paper read at meeting of the St. Ry. Assn. of the State of N. Y., with editorial discussion. 6000 w. Eng News—Aug. 4, 1910.. No. 16176.

EXPLANATORY NOTE—THE ENGINEERING INDEX

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language*, together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cts The letter A, B, or C denotes a price of 40 cts.; D, of 60 cts.; E, of 80 cts.; F, of $1.00; G, of $1.20; H, of $1.60. When the letter X is used it indicates that copies are not readily obtainable and that particulars as to price will be supplied on application. Certain journals, however, make large extra charges for back numbers. In such cases we may have to increase proportionately the normal charge given in the Index. In ordering, care should be taken to ***give the number*** of the article desired, not the title alone.

Serial publications are indexed on the appearance of the first instalment.

SPECIAL NOTICE.—To avoid the inconvenience of letter-writing and small remittances, especially from foreign countries, and to cheapen the cost of articles to those who order frequently, we sell coupons at the following prices:—20 cts. each or a book of twelve for $2.00; three books for $5.00.

Each coupon will be received by us in payment for any 20-cent article catalogued in the Index. For articles of a higher price, one of these coupons will be received for each 20 cents; thus, a 40-cent article will require two coupons; a 60-cent article, three coupons; and so on. The use of these coupons is strongly commended to our readers. They not only reduce the cost of articles 25 per cent. (from 20c. to 15c.), but they need only a trial to demonstrate their very great convenience—especially to engineers in foreign countries, or away from libraries and technical club facilities.

Write for a sample coupon—free to any part of the world.

CARD INDEX.—These pages are issued separately from the Magazine, printed on one side of the paper only, and in this form they meet the exact requirements of those who desire to clip the items for card-index purposes. Thus printed they are supplied to regular subscribers of THE ENGINEERING MAGAZINE at 10 cents per month, or $1.00 a year; to non-subscribers, 25 cts. per month, or $3.00 a year.

THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *t-m*, a tri-monthly, *qr*, a quarterly, *s-q*, semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated; W—Words; Anon—Anonymous.

Alliance Industrielle. *m.* Brussels.
American Architect. *w.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Jl. of Science. *m.* New Haven, U. S. A.
American Machinist. *w.* New York.
Anales de la Soc. Cien. Argentina. *m.* Buenos Aires.
Annales des Ponts et Chaussées. *m.* Paris.
Ann. d Soc. Ing. d Arch Ital. *s-m.* Rome.
Architect. *w.* London.
Architectural Record. *m.* New York.
Architectural Review. *s-q.* Boston.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Melbourne.
Autocar. *w.* Coventry, England.
Automobile. *w.* New York.
Automotor Journal. *w.* London.
Beton und Eisen. *qr.* Vienna.
Boiler Maker. *m.* New York.
Brass World. *m.* Bridgeport, Conn.
Brickbuilder. *m.* Boston.
Builder. *w.* London.
Bull. Bur. of Standards. *qr.* Washington.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bull. of Can. Min. Inst. *qr.* Montreal.
Bull. Soc. Int. d'Electriciens. *m.* Paris.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bull. Int. Railway Congress. *m.* Brussels.
Bull. Scien. de l'Assn. des Elèves des Ecoles Spéc. *m.* Liége.
Bull. Tech. de la Suisse Romande. *s-m.* Lausanne.
California Jour. of Tech. *m.* Berkeley, Cal.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *w.* Toronto and Montreal.
Canadian Mining Journal. *b-w.* Toronto.
Cassier's Magazine. *m.* New York and London.
Castings. *m.* Cleveland, O.
Cement. *m.* New York.
Cement Age. *m.* New York.
Central Station. *m.* New York.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Colliery Guardian. *w.* London.
Commercial Vehicle. *m.* New York.

Compressed Air. *m.* New York.
Comptes Rendus de l' Acad. des Sciences. *w.* Paris.
Cornell Civil Engineer. *m.* Ithaca.
Deutsche Bauzeitung. *b-w.* Berlin.
Die Turbine. *s-m.* Berlin.
Domestic Engineering. *w.* Chicago.
Economic Geology. *m.* New Haven, Conn.
Electrical Age. *m.* New York.
Electrical Engineer. *m.* London.
Electrical Engineering. *w.* London.
Electrical Review. *w.* London.
Electrical Review. *w.* New York.
Electric Journal. *m.* Pittsburg, Pa.
Electric Railway Journal. *w.* New York.
Electrical World. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.
Elektrische Kraftbetriebe u Bahnen. *w.* Munich.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnik u Maschinenbau. *w.* Vienna.
Elektrotechnische Rundschau. *w.* Potsdam.
Elettricità. *w.* Milan.
Engineer. *w.* London.
Engineering. *w.* London.
Engineering-Contracting. *w.* New York.
Engineering Magazine. *m.* New York and London.
Engineering and Mining Journal. *w.* New York.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penna. *m.* Pittsburg, U. S. A.
Foundry. *m.* Cleveland, U. S. A.
Génie Civil. *w.* Paris.
Giesserei-Zeitung. *s-m.* Berlin.
Glasers Ann. f Gewerbe & Bauwesen. *s-m.* Berlin.
Heating and Ventilating Mag. *m.* New York.
Horseless Age. *w.* New York.
Ice and Cold Storage. *m.* London.
Ice and Refrigeration. *m.* New York.
Il Cemento. *s-m.* Milan.
Industrial World. *w.* Pittsburg.
Ingegneria Ferroviaria. *s-m.* Rome.
Ingenieur. *w.* Hague.
Insurance Engineering. *m.* New York.
Int. Marine Engineering. *m.* New York.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron Trade Review. *w.* Cleveland, U. S. A.
Jour. of Accountancy. *m.* N. Y.
Journal Asso. Eng. Societies. *m.* Philadelphia.
Journal Franklin Institute. *m.* Philadelphia.
Jour. N. E. Water Works Assn. *qr.* Boston.
Journal Royal Inst. of Brit. Arch. *s-q.* London.
Jour. Roy. United Service Inst. *m.* London.
Journal of Sanitary Institute. *qr.* London.
Jour. of South African Assn. of Engineers. *m.* Johannesburg, S. A.
Journal of the Society of Arts. *w.* London.
Jour. Transvaal Inst. of Mech. Engrs., Johannesburg, S. A.
Jour. of U. S. Artillery. *b-m.* Fort Monroe, U. S. A
Jour. W. of Scot. Iron & Steel Inst. *m.* Glasgow.
Journal Western Soc. of Eng. *b-m.* Chicago.
Jour. of Worcester Poly. Inst., Worcester, U. S. A.
Locomotive. *m.* Hartford, U. S. A.
Machinery. *m.* New York.
Manufacturer's Record. *w.* Baltimore.
Marine Review. *m.* Cleveland, U. S. A.
Mechanical Engineer. *w.* London.
Mechanical World. *w.* Manchester.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Metallurgical and Chem. Engng. *m.* New York.
Métallurgie. *w.* Paris.
Metal Worker. *w.* New York.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci. Press. *w.* San Francisco.
Mining Journal. *w.* London.
Mining Magazine. *m.* London.
Mining World. *w.* Chicago.
Mittheilungen des Vereins für die Förderung des Local- und Strassenbahnwesens. *m.* Vienna.
Municipal Engineering. *m.* Indianapolis, U. S. A.
Municipal Journal and Engineer. *w.* New York.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Oest. Wochensch. f. d. Oeff. Baudienst. *w.* Vienna.
Oest. Zeitschr. Berg- & Hüttenwesen. *w.* Vienna.
Plumber and Decorator. *m.* London.
Power and The Engineer. *w.* New York.
Practical Engineer. *w.* London.
Pro. Am. Ins. Electrical Eng. *m.* New York.
Pro. Am. Ins. of Mining Eng. *m.* New York.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Pro. Am. Soc. Mech. Engineers. *m.* New York.
Pro. Canadian Soc. Civ. Engrs. *m.* Montreal.
Proceedings Engineers' Club. *qr.* Philadelphia.
Pro. Engrs. Soc. of Western Pennsylvania. *m.* Pittsburg.
Pro. St. Louis R'way Club. *m.* St. Louis, U. S. A.
Pro. U. S. Naval Inst. *qr.* Annapolis, Md.
Progressive Age. *s-m.* New York.
Public Works. *qr.* London.
Quarry. *m.* London.
Queensland Gov. Mining Jour. *m.* Brisbane, Australia.
Railway Age Gazette. *m.* New York.
Railway and Engineering Review. *w.* Chicago.
Railway and Loc. Engng. *m.* New York.
Railway Master Mechanic. *m.* Chicago.
Revue d'Electrochimie et d'Electrométallurgie. *m.* Paris.
Revue de Mécanique. *m.* Paris.
Revue de Métallurgie. *m.* Paris.
Revue Gén. des Chemins de Fer. *m.* Paris.
Revue Gén. des Sciences. *w.* Paris.
Revue Industrielle. *w.* Paris.
Rivista Marittima. *m.* Rome.
Rudder. *m.* New York.
Schiffbau. *s-m.* Berlin.
School of Mines Quarterly. *q.* New York.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Sibley Jour. of Mech. Eng. *m.* Ithaca, N. Y.
Signal Engineer. *m.* Chicago.
Soc. Belge des Elect'ns. *m.* Brussels.
Stahl und Eisen. *w.* Düsseldorf.
Stevens Institute Indicator. *qr.* Hoboken, U. S. A.
Surveyor. *w.* London.
Technik und Wirtschaft. *m.* Berlin.
Technique Moderne. *m.* Paris.
Tramway & Railway World. *m.* London.
Trans. Inst. of Engrs. & Shipbuilders in Scotland, Glasgow.
Wood Craft. *m.* Cleveland, U. S. A.
Yale Scientific Monthly. *m.* New Haven.
Zeitschr. f. d. Gesamte Turbinenwesen. *w.* Munich.
Zeitschr. d. Mitteleurop. Motorwagen. Ver. *s-m.* Berlin.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschr. f. Werkzeugmaschinen. *b-w.* Berlin.

Current Record of New Books

Note—*Our readers may order through us any book here mentioned, remitting the publisher's price as given in each notice. Checks, Drafts, and Post Office Orders, home and foreign, should be made payable to* The Engineering Magazine.

High-Speed Steel.

High-Speed Steel. By O. M. Becker. Size, 9 by 6 in.; pp., 360. Ills. Price, $4. New York and London: McGraw-Hill Book Company.

A considerable amount of the material in this book is based on Mr. Becker's contributions to The Engineering Magazine during the last few years, and a large number of the illustrations are taken from the same source. Section I deals with the development and nature of high-speed steels, outlining their early history and, more fully, the recent developments. To Section II, which describes the manufacture of the steels and tools, more space is devoted than to any other of the main subdivisions. The steel-making, forging, heat-treatment, and grinding processes are discussed in detail; particular attention is paid to the methods of ascertaining and regulating temperatures. Section III considers the tool at work, the range of utility of high-speed steel, the conditions of maximum effect, and the proper adjustment of speeds and feeds. The fundamental considerations in the design of new tools, the new machine requirements, and the process of remodeling an old equipment are discussed in Section IV, while Section V is devoted to a statement of the economic problems involved in the use of high-speed steels. Section VI comprises a number of appendices giving data of the composition of the new steels, the proper cutting speeds, and the cost of removing metal. The book throughout is clearly written and is a welcome addition to the literature of modern production engineering.

Works Management.

Factory Organization and Administration. By Hugo Diemer, M. E., Professor in Industrial Engineering, Pennsylvania State College. Size, 9 by 6 in.; pp., 317. Ills. Price $3.00. New York and London: McGraw-Hill Book Company.

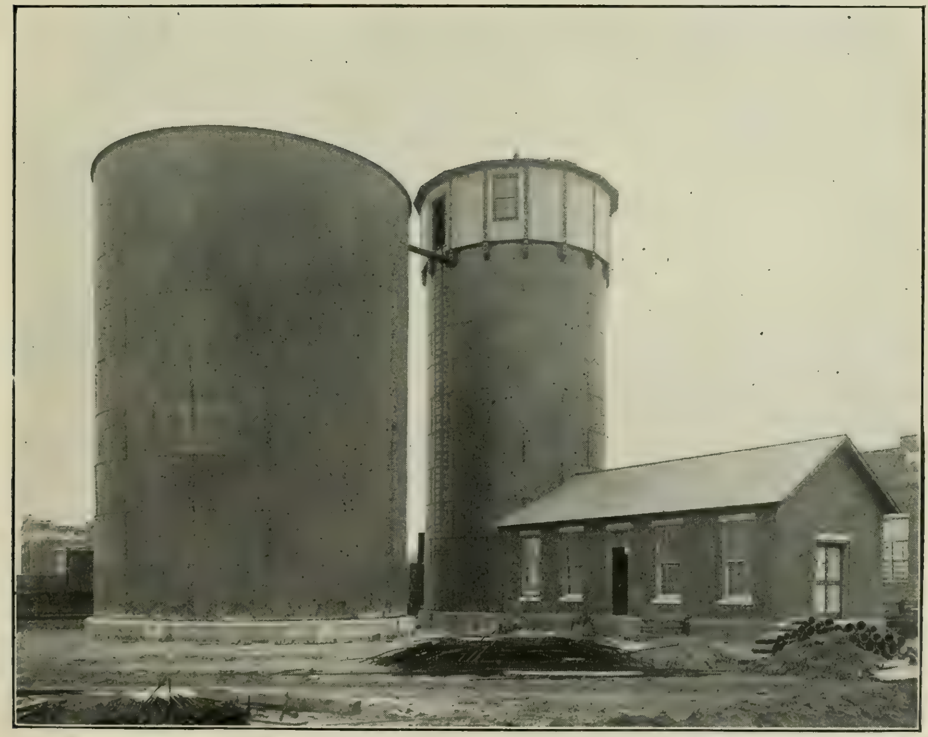
The author's preface explains that the work has gradually acquired its present form as the outcome of lecture courses delivered to senior engineering students. The subject matter and the manner of presentation and the point of view, however, seem to belong to the province of the practitioner rather than that of the student. Prof. Diemer's experience has been unusually diversified and has brought him at different times into many and various relations with many of the elements of factory administration. Probably for this reason he seems to interweave many lines of study in his approach to and treatment of the many topics taken up, sometimes with result of producing a mosaic effect, full of interesting bits, but confused as to proportion and perspective. The arrangement of the matter is in a sense logical. It begins with the economic theory of factory location, follows with the planning of factory buildings, and the influence upon design and output, takes up next staff and departmental organization and executive control, and then considers the individual departments—the general office, orders, drafting, pattern, purchasing, stores, production, foundry, machine-shop and tool room, shipping and receiving, timekeeping, and cost. After these come sections on aids in taking inventory, inspection methods, employment of labor, wage systems, fixing piece rates, the principles underlying good management, and lastly a bibliography. This is theoretically the order in which the manufacturing plant comes into existence, but it is not the order in which the individual mind proceeds to grasp the problem. The economic theory of factory location and the study of economic plant design presuppose matters which lie at the far end of Prof. Diemer's arrangement. A satisfactory introduction to the science can not be found by approaching it through these departments, however elementary the outline in which they are drawn. The work throughout is marked by diversity of information, generally by definiteness of perception and statement, but not by a satisfying analysis nor by recognition of the philosophy, or even the leading philosophies, of works management. This is particularly apparent in the chapter on wage systems. It conspicuously lacks in adequate discussion of transportation, or of that extremely important element of cost accounting, the distribution of expense. The bibliography of works management, Chapter XXVI, is reproduced verbatim from an article published in The Engineering Magazine in July, 1904, except that the present chapter adds five books to the list then given—a totally inadequate record so far as the literature of the past six years is concerned, omitting, indeed, some of the most important contributions to it that have yet been made.

THE CURRENT RECORD OF IMPROVED MACHINERY
NEW METHODS NEW MATERIALS
NEW APPLIANCES

Largest Water Softener.

THE accompanying illustration shows a Booth water softener of a capacity of 40,000 gals. an hour built in connection with the new roundhouse and shops of the Vandalia Railroad Co. at Terre Haute, Ind., by L. M. Booth Co., 136 Liberty street, New York. This softener is the largest plant of the kind ever installed, power being furnished by an overshot water-wheel at the top of the softener, all of the working parts, including feeding apparatus and regulating equipment, being placed in a substantial brick structure at the ground level.

Abandoning rule of thumb methods in water treatment L. M. Booth Co. have reduced the subject to a problem in chemical engineering capable of mathe-



BOOTH WATER SOFTENER AT TERRE HAUTE, IND.

matical solution. They are thus able to guarantee definite results at a definite cost.

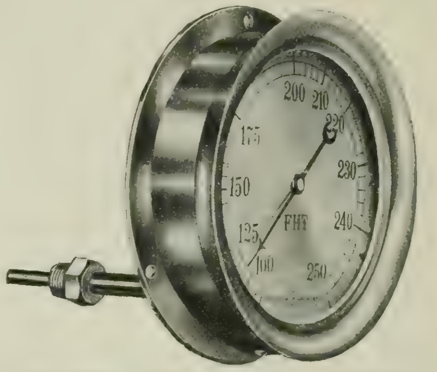
The theory of the process in ordinary cases is comparatively simple, but its success depends chiefly on the efficiency of the apparatus used to carry out the operation. That a well-designed and accurately constructed apparatus is essential to satisfying results will be apparent when the fineness of the result sought is pointed out. There are on the market few products running as high as 99% pure, and those that run 99 9-10% pure are extremely few. The starting point in water softening is even above this limit. A water which contains 14 to 15 grains of scale forming material to the gallon is hard water, yet this amounts to only one-fortieth of one per cent of impurity.

The L. M. Booth Co. publish a pamphlet, "Hard Water Made Soft," which contains much interesting and instructive information on water-softening. It will be sent free on request.

"Industrial" Dial Type Thermometers.

THE principle and construction employed in the "Industrial" thermometer make the calibration permanent, the system being absolutely sealed. It can be made in the various stem types now in use as well as the long distance type, in which the bulb is placed at the best point for taking temperatures and the dial at the most convenient point for reading them. The effective working scale is very long (about 300 degrees of a circle, or 13 inches on the 5 inch dial). It has conspicuous figures and divisions that may be read from a distance—no effort, inconvenience, or error as in reading mercurial thermometers. The form of scale is such that if the proper range is selected the working part of the scale is remarkably open and effective. The utmost sensitiveness is obtained by inserting the bulb, which is made of copper—a good conductor—directly into the fluid.

The pressure exerted by the vapor of an enclosed liquid is proportional to the temperature. In the "Industrial" thermometer, therefore, a small copper bulb is partly filled with the fluid (the kind depending upon the range) and connected by a fine bore copper tube of any desired length to a pressure gauge, which is graduated to read direct the temperature of the bulb, in degrees Fahrenheit, Centigrade or Reaumur.



INDUSTRIAL DIAL TYPE THERMOMETER.

Changes of temperature at the case or in the connecting tube do not effect the reading of the instrument when the bulb is at a higher temperature since the vapor tension is due to the temperature at the surface of the liquid, *i. e.,* in the bulb. Neither do barometric changes have any appreciable effect since they are negligible in respect to the total working pressure of the system.

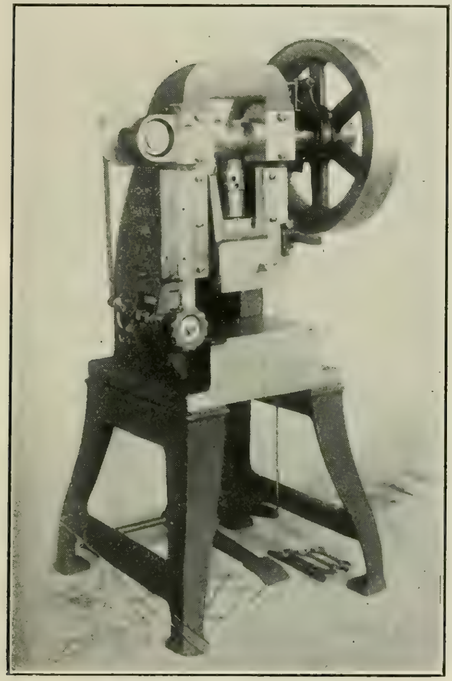
Some of the obvious uses of these thermometers are for feed water, mash tubs, vulcanizers, vacuum pans, dry kilns, cookers, rendering tanks, kettles, or in any open or closed vats, tanks, or pipes, containing gases, liquids or air, the temperature of which should be accurately known or controlled.

The "Industrial" Dial type thermometers are made in all sizes from 2½ inch to 12 inch dials and for any ranges from

50 to 500 degrees Fahrenheit. The stems may be made for practically any convenient length either bottom or back and the tube type can have the dial about 300 ft. from the bulb if necessary.

"Baird" Transfer Presses.

THIS press is a new design specially built for heavy blanking and stamping. It is furnished with seats or pads so that a plain press can first be obtained, then attachments later, which can be easily applied without necessity of shipping the press to the factory—a feature peculiar to "Baird" presses. The transfer attachment takes the place very largely of work commonly done in a cut and carry press, but is very much cheaper in first cost and up-keep, as but one set of side tools is required, and the degree of accuracy is not required in transfer tools as with a set of cut and carry tools. The automatic stop furnished with this attachment positively stops the press should the blank for any reason not be transferred to its proper position, which is a feature that saves many dollars of damage to tools.



BAIRD TRANSFER PRESS.

The open back press is furnished either with a side or back roll feed, which can be adjusted to feed the metal in either direction by simply throwing a pawl over the center. The lifting pin attachment is for raising stamped articles out of the die to facilitate their being knocked off. The friction dial attachment can also be supplied with a positive stop which stops the press automatically should the dial fail to turn to its proper position, saving damage to the goods.

Attachments can also be specially designed for the purpose. These presses are finding a ready market among jewelry, novelty, brass and steel goods manufacturers, and are found to be a very handy press, on account of its universality. Full and detailed information can be obtained from "Baird" bulletins 202 and 204, copies of which can be obtained from the builders, The Baird Machine Company, Oakville, Conn.

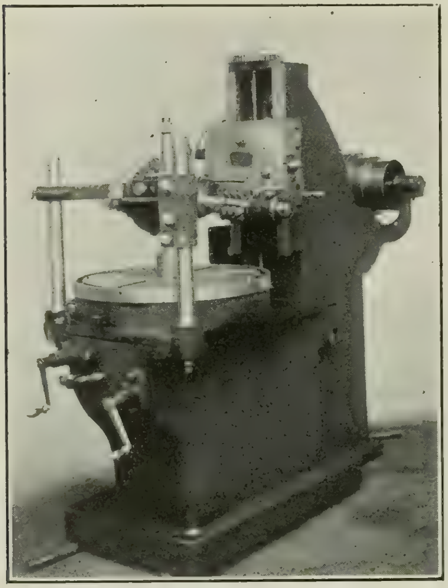
Farwell Gear Hobber.

THE accompanying illustration shows the No. 3 Farwell gear hobber. This machine is much heavier than the Farwell No. 1 and is designed for handling work up to 24 inches in diameter, 3 P., cutting 12 inches of face at a time.

The head saddle has an unusually long bearing upon the housing. The spindle has no unnecessary overhang, has adjustable bronze bearings of ample size and length and is very rigidly secured to the saddle. The compact and rigid design of the spindle support has been a feature of the Farwell gear hobber.

On account of handling coarser pitches than the No. 1 machine, this new tool is provided with a slide in the saddle that carries the hob, making it possible to adjust the hob spindle longitudinally, bringing any tooth exactly central with the work arbor. This is quite important in obtaining perfect gears in coarse pitches, but does not require attention on fine pitches, as the difference in position of two succeeding teeth is not sufficient to be noticeable in the gears.

This longitudinal movement of the spindle head permits also the shifting of the hob to a new cutting position without resorting to moving the hob or the arbor. Several shifts may be made, bringing sharp cutting parts of the hob into action before it is necessary to grind the hob.



FARWELL GEAR HOBBER.

The head has an automatic trip to stop the downward feed, and is also equipped with a power mechanism for raising the head after the cut is finished. The head, of course, returns but once for each stack of gears and on the small machine this operation is performed by hand. There are two extra feeds on the No. 3 machine, making ten, all of which are obtained in the gear box. The horizontal feed mechanism for cutting worm wheels is incorporated in the design of the machine, and supplied without extra charge, as is also the special support for upper end of arbor. This arbor support is only necessary when gears must be swung on centers, for wide face gears or in cutting a stack of gears of small diameter. A more rigid support can be secured in other cases by the use of face plates, or supporting rings which rest upon the table and support the blanks immediately below the rim.

The spindle is driven by a bevel gear instead of a belt, as the coarser pitches necessitate tilting the hob to a greater angle than the belt drive, as used on the No. 1 machine, would allow. This angle and the tooth depth are set with a hardened steel gauge as on the smaller Farwell gear hobber.

All important bearings have bronze bushings and the spindle and arbor bearings may be adjusted by simply loosening a lock ring and tightening an adjusting ring nut.

The design of the base and column of this machine is exceptionally rigid, one casting forming both, as well as the knee below the table and an oil pan around the machine. The weight of the machine is about twice that of the No. 1 hobber, or over 2,000-lbs.

A large tank to hold lubricant is enclosed in the base, and ample passages through the hub are provided to conduct the lubricant from the table back to the tank. The lubricant pump is gear driven and has means for regulating the flow of lubricant.

All gears are provided with shields, as is also the universal joint shaft. The builders, the Adams Co., 621 Bridge Avenue, Dubuque, Iowa, will furnish full details on request.

Industrial Notes.

—Garwood Electric Company have appointed George F. Herrig Company of Saginaw, Michigan, as their agents, their territory being Saginaw, Michigan, and all territory within a radius of fifty miles of Saginaw.

THE ENGINEERING MAGAZINE
"THE WORLD IS ITS FIELD"

VOL. XL. NOVEMBER, 1910. No. 2.

THE TWELVE PRINCIPLES OF EFFICIENCY.

By Harrington Emerson.

VI. THE FOURTH PRINCIPLE: DISCIPLINE.

"Undisciplined"—that is the word. It is the word for all the progress of the Victorian time, a scrambling, ill-mannered, undignified, unintelligent development of material resources. Want of discipline! The reek and scandal of the stockyards is really only a gigantic form of that same quality of American life that in a minor aspect makes the sidewalk filthy. Each man is for himself, each enterprise; there is no order, no provision, no common and universal plan.

Men are makers—American men, I think more than most men. One sees the light of a new epoch, the coming of new conceptions, of foresight, of large collective plans and discipline to achieve them.
H. G. Wells. The Future of America. Chapter 4, Section 4.

ALEXANDER DUMAS in that most famous of his novels, makes Monte Cristo the hero of one episode of marvelous improbability.

In Italy Monte Cristo had accepted an invitation to breakfast in Paris three months later and had agreed to appear on the minute. On the date appointed the other guests were assembled, very skeptical as to the coming of the mysterious Count of whom no word had been heard since the invitation. The guests are impatient—the host begs for five minutes leeway—the clock begins to strike—expectation rapidly sinks towards absoulte zero when suddenly, immaculately dressed, Monte Cristo appears saying "Punctuality is the politeness of kings, but it cannot always be that of travelers and fifteen hundred miles are not easily covered. Excuse the two or three seconds I am late."

It was beyond even Dumas' imagination to state that Monte Cristo started on his long trip also on time and made each stage of the journey day by day, hour by hour, on time. Under the dependent sequence of personal arbitrariness and unstandardized road and horse conditions it was indeed marvelous that he should arrive within a week of the time set, much less within a day, an hour, or a minute.

Now hundreds sweep over the nearly thousand-mile stretch between Chicago and New York on Monte Cristo's fraction of a minute precision. They start on the minute, they pass each station on the minute, they arrive on the minute, the passengers grumble mightily and the railroads pay rebates if there are delays.

The institution built up on time schedules has become mightier than the man and the man is immensely benefited by the discipline of the institution.

Thirty years ago along the great inland rivers of the United States, the Ohio, the Mississippi, the Missouri, the greatest difference was apparent between the river towns and the railroad towns. In the river towns steamboat passengers were quite content to wait several days, idling on the levee, whittling or swapping yarns or doing the *dolce far niente* on the hotel piazzas. When far up or down the river the deep bellow of the boat's whistle was heard, day or night, the sleepy town awakened into prodigious and spasmodic activity until the boat had come and gone; then it went to sleep again. Clocks were not needed and all business was conducted on the same easy lines. Notes were paid, not when they were due, but when the crops were marketed. An Eskimo who figures years as so many snows, months as so many moons, and days as so many sleeps, would have found the business methods of the steamboat town wholly normal—steamboat coming down the river, great excitement; whale seen in the offing, great excitement—what was the difference? In the railroad towns there was a very different spirit. People had clocks in their houses and watches in their pockets; they went to the railroad station on railroad schedule time; the coming and going of the daily trains became definite, regulating and educational events even to those who never traveled; they got into the habit of keeping other appointments; they were beginning to learn that the institution was greater than the individual.

The near discipline of the rich man who makes his servants await his convenience in spite of a definite program arranged by himself, the near discipline of some railroad magnates who more or less disarrange the train despatching on a whole system by their lack of observance of their own special train schedule, the near-discipline that would bend the sublime order of the universe to individual dilatoriness as in the story of Joshua's command to the sun to stand still, is not what is meant by "Discipline" as an efficiency principle.

There is the discipline of life which leads us, almost compels us, to follow the teaching that comes to us from intimate contact with the existing order. "The wicked shall not live half their days." It is easier to learn to fly than to make a landing. In a narrower sense we speak of the discipline of St. Francis, of St. Dominic, of Ignatius Loyola, meaning not punishment but a definite, regulated life, conduct, and observances. In the narrowest sense we use the word to denote the act of punishment inflicted on a bad boy with the object of encouraging observance of prescribed conduct or rules.

The word discipline thus has three—if not more—meanings.

Adam began to experience the discipline of life when Eve became his daily companion; discipline and the greater life began in earnest for both of them when they found themselves outside the gates, with Cain, Abel and Seth frisking around, for there is no such catagorical imperative as the sharp outcry of a very young baby. Adam and Eve, owing to lack of experience and overvaluation, spoiled Cain; so being undisciplined, his exaggerated personality could not brook the preference shown Abel and he murdered him.

Discipline as an efficiency principle includes all meanings, from lessons of life to man-inflicted punishment. The greatest regulator of conduct is the spirit of the organization.

I did not like being the only man in a dress suit at an informal business men's dinner in Boston, nor did I like being the only man in flannel shirt and mucklucks at a Nome ball. The spirit of a place is intangible, but counts for more for either evil or good than all rules and punishments combined. So powerful is this spirit that it has been cynically said most men would have fewer conscience pricks over an undetected crime than over a ridiculed solecism.

Is it not incredibly short sighted to throw to the winds such mighty helps to discipline as the spirit of the plant, the general scheme of conduct, and to place reliance in the undisciplined acts of discipline of individuals clothed with a little brief authority?

Nature is a relentless disciplinarian.

Because the success of the whole plant depends not on its wealth, or its men, or its product, but on its spirit and rule, penalties for persistent infraction should be relentlessly severe. A whole race is exterminated in Africa because through ignorance it braves the bites of the tse-tse fly. If we fall asleep in charcoal fumes we do not awake, if we touch hot iron we are burned, if we put our heads under water for five minutes we drown, if we touch through mistake a live high voltage wire, the penalty may be instant death. There are no rules and regulations about these punishments, they need no rules and regulations.

The old story runs that Eve and Adam were banished from Paradise for eating a forbidden apple and that all their descendants not only cannot get back except by very special favor, but will have to spend all eternity in hell. Cain's punishment was also exclusion; he became a fugitive and a vagabond, he was not to be rewarded for his work and he bitterly complained that his punishment was greater than he could bear. One, Cook, wrote a cheerful book about scaling Mount Bulshaio and later sent some thrilling messages about the North Pole. Not because Peary accused him, which most people resented, but because his own stories and acts proved him a liar, he had to flee, like Cain, into obscurity and oblivion although no man pursued.

Enforced resignation is one of the severest penalties in the army and navy; on a great railroad in the middle west employees were rarely discharged; they worked themselves up or down by an automatic system of merit and demerit marks. In another great American business, a large specialty store, the making and enforcement of rules is turned over to a committee of the employees. It is a universal experience that no judge is as severe and unrelenting as the more righteous contemporary with the same temptations and opportunities. It is not the child, the man, or the older woman who condemns Magdalen. It is not the child who pities the playmate killed by carelessness, it is not the successful old man who pities the grey-bearded derelict who has made a general shipwreck of life.

If the spirit of the plant does not drive an undesirable associate away, if standard operation and standard practice, both of which affect conduct, if reliable, immediate and adequate records, if absence of efficiency reward do not automatically, effectually and peaceably eliminate the undesirable, it is time for the strong hand to descend. There are certain all-night restaurants in the tenderloin district of New York frequented by roysterers of both sexes after the more reputable places are closed. A good-natured tolerance prevails for even unusual hilarity and noise, but just let any misguided guests try to start something, they suddenly find themselves seized and deposited outside on the car tracks with locked doors between themselves and joy. The disciplinary hand is resistless, immediate and strong.

Under the best management there are scarcely any rules and there are fewer punishments. There are standard-practice instructions so that every one who may know what his part in the game is, there is definite responsibility, there are reliable, immediate and adequate records of everything of importance, there are standardized conditions and standardized operations and there are efficiency rewards.

There can be organization without discipline, as in all plant life; there can be discipline without organization, as in most animal life. Because man has supernal ideals; because the progress of centuries can be lost in a year, in a minute, even (as during an earthquake) if organization is weakened—the devil indeed catching the hindmost; because our unstable human organizations, even the integrity of the family, depend on discipline, it becomes a fundamental efficiency principle which continuously, vigorously, never falteringly enforces a series of standards of high individual or combined conduct.

"He that ruleth his spirit is better than he who taketh a city." Discipline is not arbitrary rules with punishment for short-comings real or imaginary.

The tremendous simplicity of the scheme of the universe is the real marvel of it all. Universal attraction and universal repulsion—all elements have approximately the same atomic heat—but three principles underlie all life—self-preservation, race-perpetuation and the proprietary instinct. From a few elementary laws, other universal laws spring; and any near-law that cannot trace its parentage straight back to one of the supernal laws, if indeed there is ultimately more than one supernal, is probably not even a legitimate near-law.

Fine manifestations of disciplined performance are the four eighteen-hour trains each day between New York and Chicago. So unobtrusive is the perfect discipline that the passenger sees no rules or orders given, he does not see the far ahead light or semaphore signals that govern progress, he sees still less the telegraphic messages flashed by the dispatchers to the signal towers, he knows little of the duplicate orders issued to conductor and engineer. The discipline is that of the velvet paw armed with the sharpest claws, infraction possibly resulting in destruction of the whole train, a trans-human punishment; infraction, even if there is no immediate disaster, resulting in reprimand or dismissal.

Many years ago I became interested in a socialistic experiment on the shores of the Pacific. In that favored region of mild climate, tall timber, waters teeming with fish, woods alive with game, the earth covered with fertile soil, a man and woman would be justified in starting married life with a fish net, an axe and a spade, a cook pot and a jack knife. They might catch enough fish in a single day to last a whole year, and if it was not the season for fish, they could dig clams with the spade, pick wild berries in abundance, and easily split cedar logs, for canoe or hut. The skins of wild rabbits furnish blankets and clothes.

It was in this part of the country that a band of earnest men and women, some militant, some supine, some altruistic, some selfish, but all dreamers, resolved to start a socialistic colony, "to ease the strong of their burden, to help the weak in their needs." Members were either to contribute or to work. Contributing members were to pay $2.50 a month to be spent in the purchase of land, implements, machinery, and all else that the colony could not make for itself. Working members were to clear the ground, erect buildings, build boats, sawmills. Capital exacting no interest, labor never striking, were to combine in making the wilderness a paradise.

The contributing members, in case of disaster overtaking them in the outer world of competition, were to have the right to move at once to the colony where they and their children would find a ready-made home, an asylum from want and poverty, becoming working members as strength and ability permitted. Ranks of workers were to be recruited, partly from contributing members, partly by admission. The plan seemed feasible, especially as a large tract of valuable meadow and forest land was given by one of the enthusiastic founders, a theosophist who lived altruism.

I spent some time at this colony as a visitor. I met noble men and women, but I also met drones who lolled in bed while others worked, drones who expected to be waited on, and as I watched I came to admire the spirit of the beehive which ruthlessly cuts off the wings of useless drones and pushes them outside the hive to perish.

I also noted that capital and labor in combination are not enough, that the essential to direct both is after all the organizer, the disciplinarian; and I perceived that it was the discipline of St. Francis, the discipline of St. Dominic, the discipline of Ignatius Loyola, that made these great monastic and religious orders enduring and successful century after century, even as it was the discipline of the Old Man of the Mountain and his successors in spite of their atrocious practices and beliefs that maintained for two hundred years the power of the sect of the Hashishim or Assassins.

So great is inefficiency of all kinds everywhere that the application of even this one principle of discipline has produced great results through military or church organizations. Just as soon as a community bends to discipline, whether its members are followers of Romulus, of Leonidas, empires are either founded or shattered, and just a little discipline as to dress and work have made such American communities as the Shakers, Economites, Mennonites, wealthy. In the army, as in the church, the first vow is obedience; and in Schiller's ballad the slaying of the dragon did not save St. George from condemnation and punishment for his disobedience. The large office buildings in New York are peculiarly dependent on discipline. They are miniature cities in which all municipal activities, lighting, heating, cleaning, transportation, are constantly going on. As long as the tenants are present from 8 a. m. to 5 p. m. high order is maintained, but shortly after 5 o'clock discipline relaxes, attendants raise their voices, begin to smoke cigarettes, to romp, and the conviction grows that if these modern palaces were turned over as a possession to their own trained attendants, in an incredibly few weeks they would be marred and scarred, dirty and disorderly, physically and morally.

Family life can exist in the Gypsy caravan or in the Arab tent or Indian tepee, in the wolves' den or in the bird's nest, but we owe the continuance of civilization to the citizen efficiency and standard-practice engineers, men and women, heads of great institutions, governments, corporations and enterprises, who design and erect the firm skeleton of discipline that maintains in place the units of individualism, lest the whole aggregation tumble to ruin at the first shock in earth or air.

In marked contrast with the vagueness and looseness of obligation and control in the social colony that failed, is the high organization and discipline of modern baseball teams in which individual effort and reward has been happily combined with team work and collective reward. In baseball each man disciplines himself; to this is added the discipline of the team, and on top comes the discipline of the league. Without high individual standards, without team codes enthusiastically lived up to, without severe penalties to enforce obedience to the umpire and peace between the teams, the modern game would be impossible. It is the spirit of discipline, not its letter, that counts, and the spirit is reciprocal from bottom to top, from top to bottom and sideways to all associates; it is reciprocal beween the individual and the flag under which he is industriously enlisted.

I have been asked why "co-operation" was not to be considered as one of the twelve basic principles of efficiency. Common ideals striven for by a disciplined organization, supernal common-sense which forgets the little for the sake of the larger achievements, necessarily result in co-operation, even as the bees, having accumulated a full store of honey, seem to obey a queen, who "as it happened with many a chief among men, appearing to give orders, is himself obliged to obey commands, far more mysterious than those he issues to his subordinates." The fundamentals of discipline are in fact better learned from the government of a beehive than from college courses, from armies, or from any industrial organization. No bee appears to obey any other bee, no bee seems consciously to co-operate with any other bee, yet so perfect is the "spirit of the hive" that every bee engrossed in her special task, fatalistically acts on the instinct that all other working bees are also as busy for the common good, and when the drones fail to be useful the working bees become consciously indignant and make away with them. Co-operation is a matter of course, not a virtue; its absence is the crime.

Supernal discipline is inspired by a greater emotion than fear.

Frank T. Bullen, in his story praised by Kipling, *The Cruise of the Cachalot,* describes the high type of reciprocal faith that in great emergency resulted in a perfect discipline, and the story in abbreviated quotation illustrates what is meant by discipline inspired by faith.

At Port William, New Zealand, two whale ships lay, the Tamerlane and the Chance. The American Tamerlane was neat, smart, and seaworthy, but the colonial Chance looked like some poor relic of a by-gone day. Old she was with an indefinite antiquity, carelessly rigged and vilely unkempt, but the old Chance made a better income for her fortunate owners than any of the showy, swift, coasting steamers. Captain Gilroy, familiarly known as "Paddy," the master of the Chance, was unsurpassed as a whale fisher or seaman by any Yankee that ever sailed from Martha's Vineyard. He was a queer little figure of a man—short, tubby, with scanty red hair and a brogue thick as pea soup. Overflowing with kindliness and good temper, his ship was a veritable ark of refuge for any unfortunate who needed help, which accounted for the numerous deserters from Yankee whalers who were to be found among his crew. Whaling skippers hated him with ferocious intensity, and but for his Maori and half-breed body-guard he would have been killed. On that storm-beaten coast he knew every rock and tree in fog or clear, by day or night, he knew them as the seal knows them, and feared them as little. His men adored him, they believed him capable of anything and would as soon have doubted daylight as the wisdom of his decisions. One common interest, their devotion to their commander, united the very mixed crowd, sixteen European and American sailors, twenty-four Maoris and half-breeds. . . . . The Chance was there and three other whalers, competitors. Without any warning the wind flew around into the northward, putting the four ships at once into a most perilous position, and there to leeward loomed grim and gloomy one of the most terrific rock-bound coasts in the world. The Chance was a good mile and a half nearer the shore. The sea, gathering momentum over an area extending right around the globe, hurls itself upon these rugged shores. As the craft drifted helplessly down upon that frowning barrier, excitement grew intense. It would not be possible for them to escape if they persisted in holding on, but it was easy to see why they did so. Paddy, far to the leeward, was in much more imminent danger and it would be derogatory in the highest degree to the reputation of the other captains were they to slip and run before he did. He however, showed no sign of doing so, although they all neared that point from whence no seamanship could deliver them and where death, inevitable, cruel, awaited them. A gigantic barrier of black naked rock rose seven or eight hundred feet sheer from the sea. Nothing broke the immeasurable landward rush of the majestic waves towards this world-fragment. Against this perpendicular barrier they hurled themselves with a shock that vibrated far inland and a roar that rose over the continuous thunder of the tempest-riven sea. High as was the summit of the cliff, the spray rose higher so that the whole front of the great rock was veiled in filmy wreaths of foam.

Towards this dreadful spot the four vessels were being resistently driven. Suddenly, panic-stricken, the ship nearest the Chance gave a great sweep round onto the other tack. They had cut adrift from their whale, terrified beyond endurance into the belief that Paddy was going to sacrifice himself and his crew in the attempt to lure them with him to inevitable destruction. The other two did not hesitate longer.

The Chance drew in closely to the seething cauldron of breakers.—Who among sailor men having seen a vessel disappear from their sight under such terrible conditions ever expected to see her again?

It appeared that none of the white men on board, except Paddy, had ever before been placed in so seemingly hopeless and desperate a position, and yet when they saw how calm and free from anxiety their commander was, how cool and business-like the attitude of all their dusky shipmates, their confidence kept its usual high level. The test was of the severest, for to their eyes no possible avenue of escape was open. Along that glaring line of raging, foaming water not the faintest indication of an opening. The great black wall of rock loomed up grim and pitiless. All stood motionless with eyes fixed in horrible fascination upon the indescribable vortex to which they were being irresistibly driven. At last, just as the fringes of the back-beaten billows hissed up to greet them, the ship plunged through the maelström of breakers—they were on the other side of that barrier, the anchor was dropped, the vessel rested like a bird in her nest on a deep still tarn, shut in on every side by huge rock barriers. Of the furious storm, but a moment before howling and raging, nothing remained but a thunderous hum, and high overhead the jagged, twisted, tortured cloud, whirling past their tiny oblong of sky.

Such a feat of seamanship was almost beyond belief. The little, dumpy, red-faced figure, rigged like a scarecrow, bore no outward visible sign of a hero, but in our eyes he was transfigured, as one who in all those qualities that go to the making of a man had proved himself of the seed royal, a king of men, all the more kingly because unconscious that his deeds were so exalted.

If this disreputable little Irishman in the midst of filth and inadequacy could maintain, by qualities of soul alone, a discipline so admirable among a crew of flotsam and jetsam under stress so terrible, what ought not to be accomplished by leaders with all the advantages of education, experience, organization, with picked crews of workers? Unless I know that the employer is without fault, unless I know that he is struggling with an inherited, vicious condition, I have no patience with so-called labor troubles, almost always due to neglect of elementary precautions for the common benefit of master and man. There is at least one large business aggregation in the United States in which a strike is unthinkable because it is a coveted privilege to be admitted to it as a worker, a catastrophe to be cast out, and so high is the *morale* that the workers themselves make and maintain standards of conduct far stricter than any usual employer would dare to enforce although he may print and post rule after rule.

The time to inspect boiler sheets is before they are made up into steam boilers; the time to inspect anchor chains is in the making, not when the great steamer is straining with broken machinery to the windward of the Scilly Islands in a midwinter storm. In all industrial life everything is tested, materials, design, except the all-important men. In the little shop, rigidity of human inspection is high, the master looks over each man, has probably watched him for months or years before engaging him; but in the large shop, where the personal inspection of master has become impossible, even the most elementary safeguards are thrown to the winds and men are absorbed with less discrimination than the furnace under the boiler absorbs air.

No man enters West Point without passing severe elementary examinations. It is a tremendous privilege to be admitted, a disaster to be excluded. There ought to be a high membership ideal for every plant, no newcomer admitted who was not fit in every way, no man cut off except for cause. Discipline begins before the applicant is taken on. Nine-tenths of all the harder discipline ought to be applied to exclude undesirables, men who by reason of bad character, bad and offensive habits, destructive tendencies, laziness or other faults, are unfit to become working members of a high-class organization. It is before he is admitted that the applicant should hear of the ideals of the business, of its organization, of its methods.

In railroading, why should each conductor and engineer be compelled to secure a watch of the best grade, why should this watch be periodically inspected, yet the future conductors and engineers be recruited in the most haphazard fashion? There is scarcely any greater or crueler injustice to a boy or to a young man than to allow him to enter on a career for which any competent examining committee would tell him he was unfit, there being other careers for which he is better adapted.

In coal mining, seams of coal with bands of slate, clay, or dirt are not mined, or the coal is carefully picked over, or washed; in lumbering all material is graded, millions of feet of inferior grade being burned; in wheat raising the farmer strives to attain grade; standards are devised and rigidly adhered to in the live-stock markets; but a company building cars or running a factory or mining coal will engage and employ almost anyone that applies for work, who is not under age, over age, or absolutely crippled.

The master organizer, whether saint or assassin, does not admit those who would make trouble and thus avoids nine-tenths of possible insurrection, the master organizer creates a collective spirit that prevents another nine-tenths of disciplinary troubles, a dependent sequence that brings his remnant of insubordination down to one per cent of the usual and possible and with this one per cent of remnant he easily deals.

As I write, the morning papers contain three items. "Manchester, England; The Federation of Master Cotton Spinners has locked out 130,000 men. Berlin, Germany; Negotiations with the object of preventing a lockout of the metal workers have failed. Nearly 100,000 men are affected in Berlin alone, it is estimated that at least 500,000 throughout Germany will be turned out. Paris, France; 80,000 strikers tie up railroads. Entire country may soon be involved."

Whatever the merits of the cases, it is safe to say that most, if not all, the principles of efficiency were flagrantly absent in these three great disputes. In the case of the cotton spinners the story runs that a worker was discharged by a foreman because he objected that certain assigned work was not in his line. Ought it to be possible for two men in the bottom ranks of a great business to bring on a strife involving 130,000? Were his duties made clear to the worker before he entered the company's employ? Ought the foreman to have had the power to discharge him for an objection, on its face, entirely reasonable and sustained by his fellow workers? In this dispute we have the old-type, arbitrary, anarchical organization of both masters and men. We find first of all defective discipline, rejection of competent conciliatory counsel, painful absence of common sense, and no high ideals.

Under efficiency principles there would have been staff advisers to invent and build up safeguards against catastrophies of this nature, just as levees are built along the banks of rivers inclined to flood.

Trouble-making men, whether workers or foremen, could neither have gone on the payroll nor have stayed on it. There would have been staff conciliators whose business it would be to take in hand incipient emotional flames and smother them before they grew into great conflagrations.

The principles of efficiency are not vague platitudes; they are intensely practical remedies, tested, tried out, and successful in preventing wastes, preventing the losses caused the State and community by the cessation of labor of hundreds of thousands of men, preventing the greater misery and suffering due to the enforced idleness of heads of families. While master and man quarrel and bicker, the State suffers and women and children pay the penalty. Socialism gains recruits not from the arguments of its advocates, since no human being is naturally a socialist, but from the unendurable shortsightedness and shorter temper of individualistic men.

It is not enough for the owners to have ideals; they must be transmitted to the employee, and nothing is easier, as any one who has studied the psychology of crowds knows; but it is idle to expect the average worker to rise above the spirit of the place he works in. If it is untidy, disorderly, filthy, if the accommodations for his necessities are lacking or vile—imposing steel and concrete construction, saw-tooth lighting, compound condensing engines, and all the over-equipment to which in the past we have pinned our faith, will not inspire the worker.

On one occasion, beginning an investigation of a great machine shop employing one thousand men, I went the first morning at half past six to the power house. It was a dark day early in February, temperature 8 degrees below zero and the shops were none too comfortable. When the whistle blew at seven o'clock I watched the ammeter line. The power consumption rose instantly to what proved to be the average maximum and it stayed up. I returned at 11:30 and watched the ammeter line stay up until 11:57 at which time the record, reliable, immediate, and adequate, began to round off, suddenly dropping as the noon whistle blew. It came up again at 1 o'clock and stayed up until 6 o'clock. The two parallelograms were very different from the flattened records, shaped like half ellipses, so usual in similar shops. It was evident that the superintendent was a man of discipline, and the opinion I formed in that forenoon of his ability was confirmed by three years' intimate association. It was his practice to enter the shop at 6:30 a. m. to stay until after 6 p. m., and I heard him severely reprimand a foreman for allowing the superintendent's father, a worker in the shop, to take off his overalls five minutes before closing time. Men worked enthusiastically, loyally, and reliably for this master of men.

The way to guard against trouble is to make the position desired by a superior man, to allow it to be filled only by a superior man, to maintain the position at a high level. If the owners and managers of a plant of any kind are orderly, enthusiastic, loyal to the work, punctual, courteous, decent, competent; if they feel their obligations towards those they direct; if they are honest, economical, diligent and sound in health, they can well demand similar qualities in all the employees. I have placed order first, believing in the spirit of the proverb that order is nature's first law and also the remark which Goethe puts into the mouth of Mephistopheles: "Make use of time, it is so fleeting, but order saves time." No man ought to be allowed to enlist who cannot start in with order, enthusiasm, loyalty, reliability, who is not courteous and decent; no man ought to expect to stay who is not competent, a good brainworker, honest, economical and diligent. If in addition he has good health, so much the better.

The self-executing discipline that is worthy to be an efficiency principle is the allegiance to and observance of all the other eleven principles, so that the twelve principles do not become twelve rules unrelated to each other; they do not become separate and easily dislodged rails of a fence, which is more an indication of boundary than a barrier; they do not even become the iron palings of a French fence, whose spacings as a boy I had carefully tested by my head, knowing that where this member could pass my body could slip through—much beloved interstices, an ever ready path to safety when pursued by outraged minions of the law or exasperated householders or other representatives of the established order against which I was in perennial rebellion. As promoters of observance of arbitrary rules to which as a free American boy I had not given my assent, these elaborate fences were joyful failures.

It is otherwise with the rabbit-proof, dog-proof, hog-proof, bull-proof, wire-netting fence whose meshes cannot be squeezed apart, whose barbs punish familiarity, which is strong enough to kill outright an animal running diagonally against it.

The twelve principles of efficiency are the strands of a net, each interwoven with the other so that in reality the first study of any organization is to find out to what extent common-sense, competent counsel, discipline, and the other eight principles have been applied to the first principle, "Ideals"; to find to what extent ideals, competent counsel, and discipline, have been applied to common-sense; to find to what extent ideals, common-sense, competent counsel, have been applied to discipline. Any system or act of discipline that cannot pass the test of each of the other eleven principles is near-discipline, not supernal discipline—is a remnant of arbitrary individualism, the first misstep in an anarchy that will extend all the way down the line.

No efficiency principle stands alone, each supports and strengthens all the rest, each is supported and strengthened by the other eleven. They are not as mutually interdependent as the stones of an arch, each a key stone which if removed brings about the collapse of all the others; they are more like the stones of a dome, any one of which can be taken out, leaving a weakened, but not a destroyed structure.

DIVISION OF LABOR IN BITUMINOUS COAL MINING.

By W. E. Fohl.

Mr. Fohl's article speaks for itself by its able and clearly presented thought. It is placed beside Harrington Emerson's statement of efficiency principles so that emphasis may fall on the sympathy in operation of two minds working independently on similar problems—the one general, the other specific. Mr. Fohl connects the admitted inefficiency of bituminous coal mining with certain definite factors:—an evasion of the fair deal by the operating companies; lack of competent counsel to the miners; lack of standard-practice instructions; incomplete discipline. These involve four of the Twelve Principles of Efficiency. When different investigators working separately arrive at substantially identical results, it greatly strengthens the argument that these results embody fundamental facts or natural laws and principles.—THE EDITORS.

WITHIN the last two decades there has been an enormous expansion of the bituminous coal-mining industry, from a production of 111,302,322 tons and the employment of 192,204 men in 1890 to a production of more than 300,000,000 tons and the employment of more than 500,000 men in 1909. This growth has been accomplished partly by the discovery and development of new coal areas and the multiplication of operations in the older mining regions, but principally by increasing the productive capacity of individual operations, few plants being now built of less capacity than 300,000 tons annually.

During this period engineering talent of a high order has fastened its attention on the perfecting of the physical organization, and carefully planned surface plants, durably built of masonry and steel, and every conceivable device for the economical handling and preparation of the product have resulted. It is a matter considered no longer noteworthy that the trend of the coal seam is determined in advance of operation and that workings are developed along lines previously laid down with but little more variation than the architect finds necessary in his detail drawings of a modern high building. Transportation is effected over roadbeds rivaling trunk-line railways for solidity and permanency, by steel cable, and the more mobile electric or compressed-air motor. Machinery has been applied to the cutting of the seam preparatory to its dislodgment, usually by blasting, and there is continually seen, just ahead, the machine that will cut and load the coal without the intervention of the miner's pick and shovel.

But for each 600 odd tons of coal produced annually there is still required one man, and the aggregate of these requirements for 1909 was more than half a million men. While the physical organization has been gradually brought to a high state of efficiency this great body of labor, as a whole, has deteriorated.

This deterioration has been due to racial changes in the personnel of the workmen, but the casual inference that it is solely due to the inferior mentality of the supplanting Slavonic and Latin races is by no means borne out by intelligent observation. The early miner of British extraction, English, Scotch, Welsh, came into the mines of the United States as a journeyman who had served his apprenticeship in mining communities whose members took their place at the working face in early youth, and in addition, was equipped with a language common to himself and his employers. The later immigrant, however, was an alien in language and was without industrial experience, being the product of agricultural communities. That he is amenable to discipline is a matter of general agreement, and that he is susceptible of training is demonstrated by the number of first-class operations manned by these aliens in all departments except those requiring special mechanical skill or a ready command of the language.

A brief review of the processes of coal production is necessary to determine whether they have been adapted to the securing of the greatest efficiency from untaught labor. The description applies to room and pillar mining which is practiced with very few exceptions throughout the United States.

Formerly the operating company assumed responsibility for the labor only to the entrance of the working place; beyond there the miner was in effect a contractor, who, at a fixed price per ton or wagon of coal, undertook to perform all necessary labor connected with the mining of the coal. He furnished his own tools; laid the track connecting his working face with the company's haulageway, material for this being furnished by the company; and placed the supports for the roof, also with furnished material. The actual mining of the coal he performed by making an undercut at or near the bottom of the seam, afterward dislodging the overhanging coal by blasting or wedging. Some important exceptions to this general method of procedure were the use of a side cut, known as shearing, either with or instead of the undercut; the blasting of the coal from the solid, omitting both the undercut and the shearing; and, in some localities having coal softer than the ordinary, digging the coal from the solid face with a miner's pick. The miner's labor finished with the loading of the dislodged coal into the wagon.

The loading of the coal into the wagon is the only part of the process not requiring skill in a greater or less degree. In all the labor the miner was left to his own devices, receiving no supervision nor instruction other than could be given during a hurried visit of the mine foreman or his assistant—a visit seldom occurring more than once daily, and seldom of more than a few minutes duration. The working place belonged to the miner, and so long as he was in the employ of the company, no matter how irregularly he worked, it was reserved for him.

The first encroachment on the miner's ownership of his working place was occasioned by the introduction of machinery for cutting the coal more than a decade ago. This machinery, being entirely outside the average miner's experience, from the first called for specially trained operatives and there has never been a suggestion that a knowledge of its operation should be a part of the equipment of the ordinary miner.

The next step in this direction has been the general demand to have the use of necessary explosives put in the hands of men specially trained in their use. As many of the disasters of recent years have been attributed to unskilful use of explosives, this is being widely done with little opposition. In machine mines with shot firers in company employ there is left, then, for the miner the timbering for roof support, the track laying, the drilling of holes for blasting, and the loading of the coal.

The next step in progression—the assumption of the skilled parts of this labor by the operating company, leaving to the miner only the loading of the coal—has scarcely been seriously broached. This has been due partly to a fear of incurring an extra legal responsibility, if timbering were taken out of the miner's hands, and partly to the very natural idea that the miner is more vitally interested than any one else in the preservation of his own safety. This, however, overlooks the inclination to take dangerous chances common to the workers in all hazardous occupations. It is a belief, too, of common acceptance about mines that experienced miners are more likely than raw recruits to be killed by negligence, and a reading of mine-inspectors' reports shows a majority of accidents caused by falls of roof and coal to have occurred after warnings given by those in authority, or by disobedience of rules for the regular placing of supports.

It is easily understood that this labor can be more efficiently performed by men trained for it and constantly engaged in it. Holes for explosives can be placed where they will be most effective, tracks can be laid so that delays from derailed wagons will be at the minimum, and timber can be set where it will give needed support. But most important of all, these things can be done a shade in advance of their actual need, a thing now impossible of practical performance, because the miner's pay is gauged solely by the quantity of coal loaded in his wagon, and these so essential parts of his labor are extras upon which no unit price is, nor can readily be, placed. It seems almost superfluous to add that observation shows the miner constantly bending his energies to the filling of his wagon and constantly being driven to the performance of these extras.

There seems to be little question but that a more rational division of these various labors would make for greater efficiency, especially in mines using machinery for undercutting. Such a division would make use of the present machine runners with no change, these to be followed by men to perform both drilling and shooting. Following these last would be the timbermen who could also have charge of road laying. All of these to be in company employ and working for a fixed daily wage, except the machine runners who could be paid for tonnage cut, as they are now.

An objection to this suggested plan will be found in the fear of employers that their assumption of the miner's timbering duties will make them directly liable for all personal injuries from falls of roof and coal. It will be objected, too, that this plan will cause a disturbance of existing wage scales which have been arrived at only after bitter contention with the miners through their organizations or otherwise.

The welfare of society demands that the first objection should be erased. When the employer has exercised all possible diligence in the furnishing of men and material, such accidents as are unavoidable are properly a charge upon society as a whole, and a world-wide movement is now in progress to fix by legislation the manner in which society shall pay its debt to the laborers injured in dangerous industries, as well as the manner in which it shall care for surviving dependents.

As for the second objection, the disturbance occasioned by the change in wage scales would be only temporary and future modifications would be materially simplified. As it now stands in this industry, the fixing of wage scales is an attempt to secure an impossible uniformity. The hardness of the seam, its thickness, the character of the roof, are all factors influencing the amount of coal possible of production by the miner. But suppose the working place prepared and the coal dislodged; the miner, or, as he would then be called, the loader, would nearly everywhere perform the same amount of paid labor. The men employed by the day to perform the labor now included with the miner's labor as extras would have their wages fixed with little regard also to mining conditions. They must have a living wage wherever situated. To have them earn this is a matter of supervision, and not necessarily a great deal more supervision than is already being exercised.

The advantages to be derived are far reaching, notwithstanding the apparent simplicity of the change. The loading which consumes roughly three-fourths of the miner's working time would, in consequence, give employment to a large body of men needing no knowledge of the language and no ability other than that involved in the manipulation of a shovel. Work suitable in character would thus immediately be provided for our Latin and Slavonic recruits; their training as citizens and, for those of native ability, as skilled workmen, could then be conducted in a leisurely and systematic manner and not at haphazard as at present.

The death rate in American mines which has been the cause of so much unfavorable comparison with that of European mines would be greatly reduced; for more than half of the fatal accidents are caused by falls of roof and coal. The skilled and unskilled workmen are alike sufferers in this particular, and the proverbial stitch in time is far more likely to be applied by men whose sole occupation is the securing of safety and whose daily earnings are not enhanced by procrastination or slipshod work. Discipline which has for its object the safety of the person disciplined is in America practically impossible of enforcement. Yet, vigilance must be enforced and there seems no surer method of enforcement than to bring it into prominence by making it a paid labor.

A surplus of development is nearly always present in bituminous mines. Idle working places exist for various reasons. Temporarily, because the miner is prone to holidays; and for longer periods, because he is of a vagrant disposition and his unfinished working place is viewed with suspicion by a new arrival. Any untoward natural condition immediately makes a working place highly undesirable, and even a fair premium will seldom secure its continuance. Now, every developed working place represents an outlay of capital and its idleness is more than mere idleness of capital; it is a bill of expense, not only for its own maintenance but in its retarding effect on the general development. Full recovery of a seam requires that a section once opened shall proceed to exhaustion without pause. This can be accomplished only by a greater mobility of working forces, allowing them to be concentrated at will where needed.

It has come to be a truism that in any industry a study of its human components is of paramount importance. The industry in question deserves a closer study on its human side than any heretofore accorded it. The conditions here reviewed are in themselves trivial, and in an industry employing labor in small numbers would be of little moment. But when it is considered that these conditions are bound fast to one of the major industries of the nation by long years of tradition, and when it is considered that the energies of the larger part of half a million workmen are being inefficiently and dangerously directed, they demand examination in all seriousness.

INTERESTING RAILWAY ACHIEVEMENTS IN NEW ZEALAND.

By W. Wilson, B. E.

A large part of the activity of the engineering trade in the past half-century has been based on the development of new territories—especially railway development and its contributory industries. The next very few decades seem certain to witness some change in the distribution of this activity, following the satisfaction of the larger needs of the greatest of the newer continents and the turning of American manufacturers to foreign markets. Hence there is added interest in this short survey of work in a country where the realization of opportunity is still in its active youth.—The Editors.

THE small Dominion of New Zealand has what may justly be considered an extensive railway system. Though the average life of the provinces, which go to make up the colony, is only about 70 years, yet just under 3,000 miles have already been laid down, and the existing lines are being extended at more than a dozen points. This work is being done, and has been done in the past, in the face of great natural difficulties, and as the easiest routes (as might be expected) were proceeded with first, these difficulties are increasing still further. I propose to give a brief description of the methods by which the obstacles met with have hitherto been overcome.

The first railway in the country was the port line constructed by the Canterbury government to connect Christchurch with the sea. It was undertaken soon after the landing of the colonists in 1850, and trains were actually running to the temporary harbour on the Avon, a distance of about six miles, only a dozen years after the arrival of the historic first four ships. At the same time a far bolder project was begun, in the drilling of a long tunnel through the hills, forming the old crater wall in which Lyttleton harbour is situated. At that epoch this was a unique project. For one thing, it was the first time that an actual crater had been pierced, and great interest in the boring was taken all over the scientific world. But a more important consideration, as far as the work itself was concerned, was the extreme hardness of the rocks encountered, which turned the edge of all varieties of steel tried by the contractors. So serious was this trouble that the latter, a well-known English firm, relinquished the work, and for a time it threatened to remain permanently at this early stage. However, a representative was sent to England, who succeeded in placing

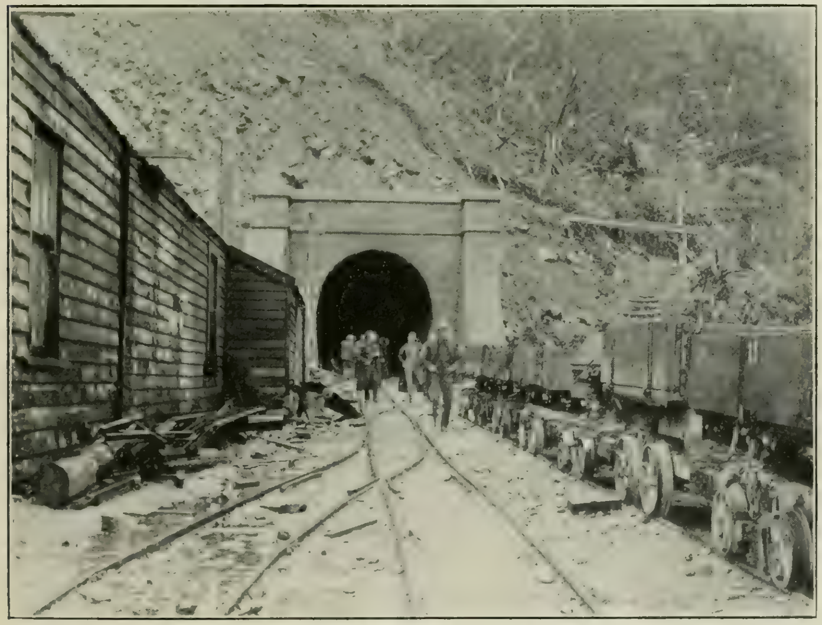
STRIPPING WITH PICK AND SHOVEL FOR THE EASTERN FACE, OTIRA TUNNEL.

the steel manufacturers on their mettle, with the result that a suitable product was supplied. Drilling was again begun, this time by a local firm, and the 1⅝ miles were completed in 1869. The Canterbury government subsequently extended their system which had a 5-foot 3-inch gauge, to a total extent of about 60 miles, when the provinces were amalgamated, in 1876, and the newly formed Central govrnment decided to reduce this gauge to the more economical one of 3 feet 6 inches.

The Otira tunnel, at present being constructed through the Southern Alps about 80 miles west of its forerunner, has the distinction of being at present the fifth longest in the world, and is the crowning achievement in a line of unusual difficulty. The mountain section of this railway during which the ranges are negotiated, is of about 65 miles in extent, and is just nearing completion after a vigourous contention with a multitude of difficulties. In particular, the 10 miles in which the Waimakariri gorge and that of its tributary, the Broken River, are followed, included a whole host of problems. There are, in this brief stretch of line, five big viaducts ranging from 110 to 236 feet in height. Seventeen tunnels of 8 to 30 chains, and a tremendous amount of heavy earthwork, besides smaller bridges and culverts.

At the summit occurs the Otira Tunnel of 5 miles, 25 chains, making its way through the heart of the range beneath the famous Otira gorge. A local firm is at work upon it, and hopes to complete it within five years, of which three have now gone, at a contract price of £600,000. The eastern end is the highest point of the line, being 2,435 feet above sea level, and from there a grade of 1 in 33 takes the tunnel down to the western portal, 1,585 feet above the sea. Pneumatic percussion drills are employed on the sandy slates encountered, and a total progress of between 120 and 170 feet per week is made. Power is supplied by two hydroelectric stations of 600 horse-power each, and at the present time all is working steadily.

A radically different solution to a similar problem has been carried out in the crossing of the Rimutaka range by the main line connecting Wellington with Napier and the thriving towns of the Wairarapa district, in the North Island. Whichever way the surveyors sought to take the railway, this great obstacle blocked the path. One especially weak place, however, was found in the Rochfort Saddle, 1,448 feet in height; and it was decided that advantage should be taken of this gap. The drilling of a summit tunnel, about half a mile in length, lessened the climb by very nearly 300 feet, but even so, a



THE OTIRA TUNNEL PORTAL.

grade of 1 in 15 for the 2½-miles descent on the northern slope could not be mitigated by any practicable means. After a consideration of the various methods for climbing such an incline, the Fell system was chosen, and since the opening of the line in about 1880, it has smoothly and satisfactorily performed the heavy duty entrusted to it.

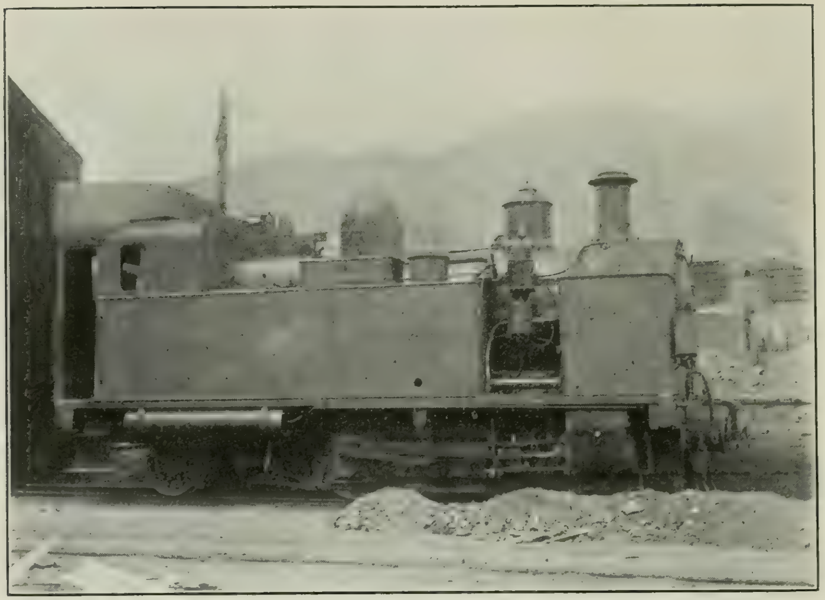
A FELL ENGINE, RIMUTAKA INCLINE.

A brief description of the Fell system may here be given, as at the present time no well-known example other than the Rimutaka line is in existence. Its invention and first appearance were due to the advisability of establishing a temporary connection between the railheads at either extremity of the Mont Cenis tunnel, when it seemed

A TRAIN DRAWN BY THREE FELL ENGINES CLIMBING THE RIMUTAKA INCLINE.

probable that the slow process of drilling then in vogue would delay the completion for about 25 years. Accordingly, a railway was designed by Mr. Fell, and built, leading over the great Echelle above the tunnel. It fulfilled its duties in the most satisfactory manner until the permanent line through the mountain was opened in 1871. The system consists in the provision of a "grip" rail, midway between those forming the track, and raised some 4 or 8 inches above them. Inside the framing of the locomotives is a secondary engine, operating special small driving wheels which can be compressed against the sides of the third rail. Slipping is thus done away with, and the required degree of tractive force obtained. The third rail is also used for braking, large iron shoes being closed upon it both by the locomotives and also by special brake-vans included in the train. In one trip down the incline, the iron brake blocks are often worn completely through, and the refitting of these at every passage is one of the incidental duties of the large staff of men kept busy at the foot of the hill.

The grip rail is composed, as can be made out from the illustration, of an ordinary double-headed track-rail supported sideways on chairs attached to the sleepers. In addition to its normal functions, it is also valuable in steadying the engines round the sharp corners of the descent. The older engine equipment consists of six Fell, or H class locomotives, of the type shown opposite. They weigh 39 tons, and have a tractive power of 21,320 pounds. In making up the train,

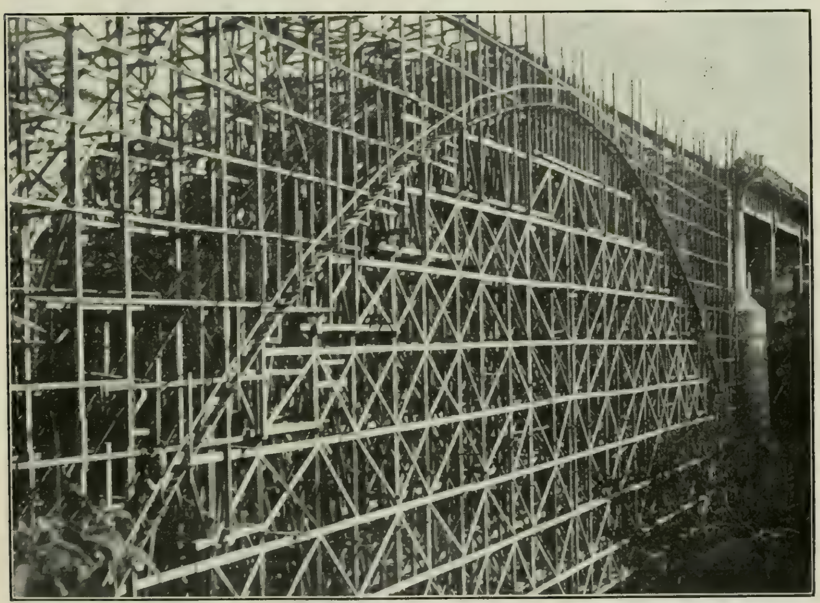


AN H CLASS ENGINE, RIMUTAKA INCLINE, NEW ZEALAND RAILWAY.

an engine is used to every three or four carriages, so that an extra heavy load may demand no less than five locomotives. About fifty minutes are consumed in climbing the hill, giving a speed of only about three miles per hour.

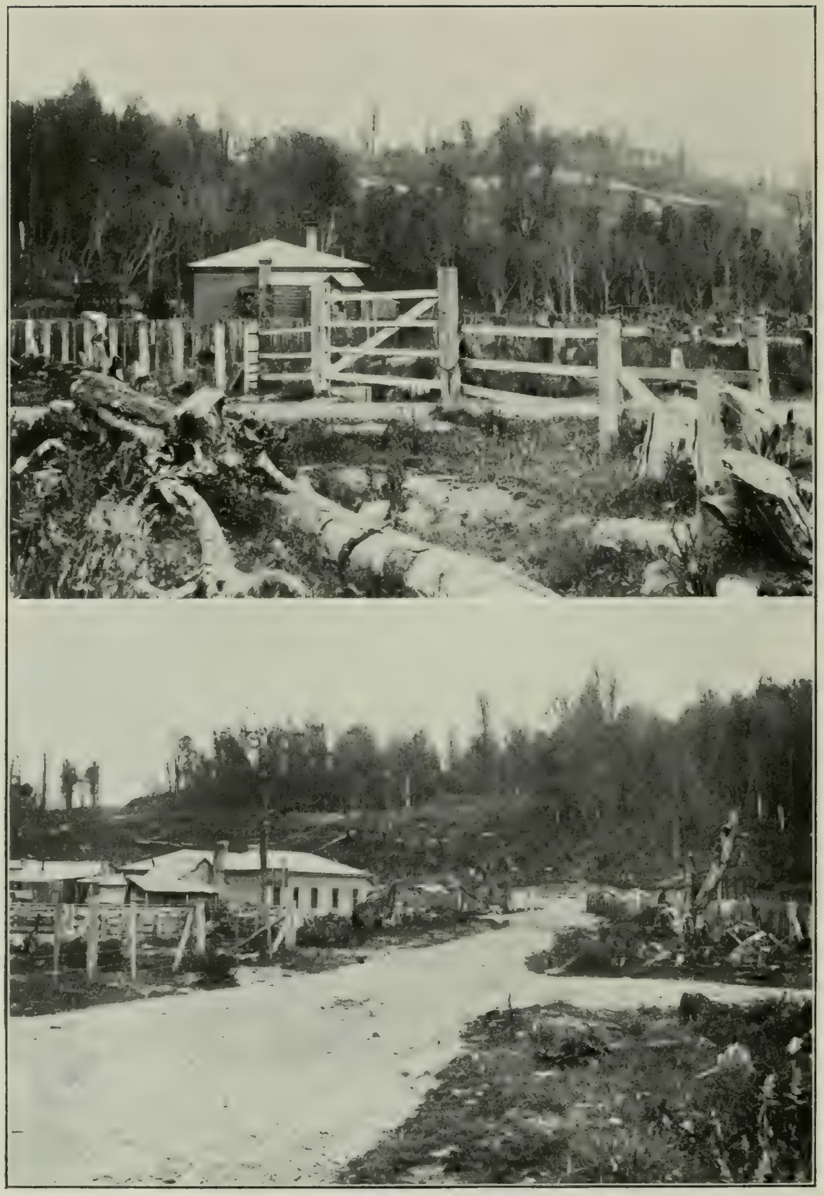
A new and most interesting type of engine has lately been added to the stock at the incline, working upon the ordinary principle of simple adhesion.. It is of the 2-6-6-0 type, with separate cylinders on each set of driving wheels. The boiler pressure is 200 pounds, as compared with 140 pounds in the case of the H, and the cylinders are of the Vauclain compound type. There are therefore eight altogether, and they can all be supplied with high-pressure steam for emergencies. The total weight is 65 tons, 17 hundredweight, and the normal tractive power is 24,200 pounds. A specially interesting feature is the use of a circular firebox of corrugated steel. This engine, known as an "E" in the N. Z. R. classification, has worked well ever since its completion in 1905.

On a larger scale than any of the above mentioned lines is the Main Trunk Railway of the North Island, which, about two years ago, first established communication through the rugged uplands of the almost untrodden King Country. From Wellington to Auckland its total length is 425 miles, but the most difficult portion occurs between Marton and Frankton Junctions, roughly 100 miles from each end. In this stretch of about 225 miles, the line twice crosses ridges of over 2,660 feet above sea level, hairpin curves and a spiral being required to keep the grade down to 2 per cent, the maximum adopted. A large number of great viaducts occur, the highest being that over the Makatote gorge, in which the track is 260 feet above the river-bed. Tunnels are not by any means frequent, when we consider the mountainous nature of the country. Much heavy work, however, has been put into cuttings, the track in many places ascending or descending from one level to another by a shelving cut out of the hillside. Much of the line penetrates dense forest, and often beautiful gorges are followed for considerable distances. Consequently, the scenery is frequently most charming, and the spice of adventure introduced by the crossing of spidery viaducts far above the serpentine waters of the rivers below, unites to make the journey an enjoyable experience.



FALSE WORK, GRAFTON BRIDGE (FERRO-CONCRETE), AUCKLAND, NEW ZEALAND.
About 400,000 feet of timbering. Span 320 feet, height about 150 feet. Local cement used.

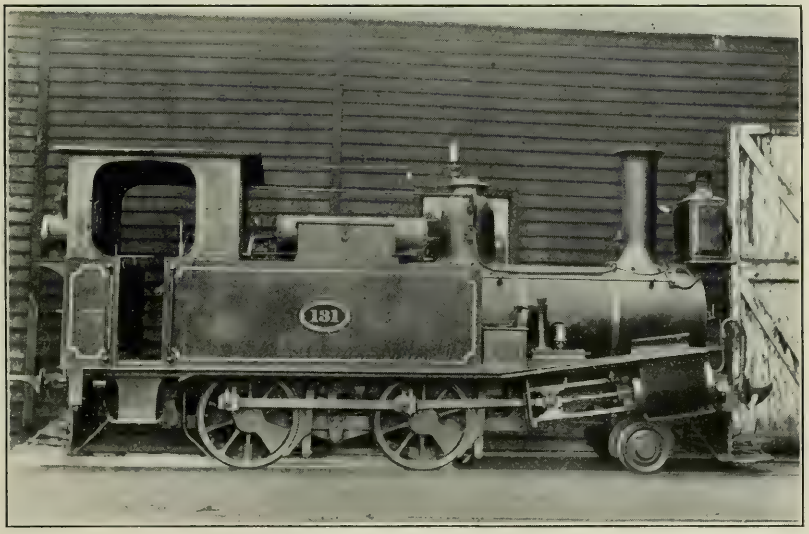
Without doubt the most interesting features in connection with the Main Trunk Railway are the spiral at Raurimu and the huge compound locomotives that draw the trains over such difficult country. Raurimu is situated at a point where the line, having mounted the steep ascent in the beautiful Whangapapa gorge, reaches a height of



ALONG THE RAURIMU SPIRAL.

The bottom and second levels cross the lower picture; the top or third level is seen in the upper picture.

1,922 feet, and is confronted with a barrier in the shape of a bush-clad ridge, 435 feet high and only a mile and a quarter distant. To surmount this by a 1 in 50 grade requires nearly 4½ miles of tortuous travelling, in the form of a sharp hair-pin curve of one mile in length, which brings the train almost immediately over its starting point and 88 feet higher up; a spiral of roughly a quarter of a mile in diameter, by which a further gain of 75 feet accrues, together with other snake-like windings about the sides of the Piopiotea valley. There are thus three levels visible at the one time, and these can all be distinguished in the accompanying photographs, the intervals between the visible points of the line being exactly a mile in each case. Two tunnels occur, the longer, of 19 chains, serving to take the track beneath the portion of the line that crosses it, 75 feet overhead. Passengers derive great entertainment from watching the township appear and reappear, each time further beneath them than previously.



CLASS D SHUNTING ENGINE, NEW ZEALAND RAILWAY.

Two classes of locomotives are used on this line, resembling each other in their general characteristics, but differing in detail according to the work each is designed for. Both are compound engines of the de Glehn type, in which the high-pressure cylinders are inside the frame, driving upon cranks forged in the leading driving axle, and the low-pressure cylinders are outside, and work upon the second pair of driving wheels. For a distance of 175 miles from Auckland and 160 miles from Wellington, class A locomotives (4-6-2) are

THE RAURIMU INCLINE.
Bottom level (in the distance) and second level, taken from the third level.

used, with 4 foot 6 inch driving wheels and a boiler pressure of 225 pounds. The cylinders are 12 inches and 19 inches diameter, respectively, by 22 inches stroke, the total weight is 72 tons 4 hundredweight, and the tractive power is 17,440 pounds, working compound. This class of locomotive is capable of speeds on the level up to 50 miles per hour, with a normal load. Over the intervening 91 miles, which include most of the greater difficulties of the trip, class X engines (4-8-2) are employed, with driving wheels only 3 feet 9 inches in diameter and a working pressure of 250 pounds, almost a world's record for a locomotive boiler. The weight of these narrow-gauge monsters is 91 tons 15 hundredweight, and they are propelled by cylinders of 13½ inches and 22 inches diameter by 22 inches stroke, giving a tractive power of 29,840 pounds. They are designed for a speed of 25 miles per hour, and can take a heavy train up the spiral at 20 miles per hour. These two classes, as well as the E mentioned before, are of local construction, and are certainly a great credit to the Government railway authorities.

These are the chief of the bold expedients which have been found necessary to connect the various parts of New Zealand by rail. Needless to say, they have involved great expense on the part of the constructors. Railway communication, however, is rightly regarded as a necessity, rather than a luxury, and where heroic measures were unavoidable, these have been fearlessly adopted. The result is a system extending from end to end of this mountainous country, surely an achievement by no means discreditable to a community of less than a million inhabitants.

EUROPEAN LIFT-VALVE ENGINES.

By Warren H. Miller.

Mr. Miller's article this month may be read in immediate sequence with his preceding contribution on the "Locomobile, or Superheated-Steam Unit." It is a brief review of advanced Continental practice which may be of interest to steam engineers, engine builders, or users of motive power and machinery.—The Editors.

IN America the principal objections to the use of superheated steam in large slow-speed horizontal Corliss engines lie in the facts that cylinder oils flash at temperatures of superheated steam between 450 and 580 degrees, and that ordinary soft valve-rod packings are apt to char and harden with these high temperatures. The advantages, however, are undeniable in reducing cylinder condensation, and it seems a pity to have to use one-third more steam than is really necessary simply because of a little cylinder oil and valve-rod packing. While ordinary slide valves, or other established types and the like are out of the question for even moderate degrees of superheat, it is a fact that a specially designed, balanced light piston valve with cast-iron bushings and rings will run for years without lubrication and at 587 degrees of superheat, as witness the Wolf locomobile units using this valve. But, since as far back as 1873, European engineers have been experimenting with what is known as the *soupape* or *ventil* gear in France and Germany, which consists essentially in vesting the control of steam distribution in balanced double-seated lift valves, very similar to the Stevens poppet-valve gear, so extensively used in America ferryboat engines. The objectors to this system urge that the valves require frequent re-grinding to remain tight, that any grit under the seat will ruin the edge of the valve, and that they never wear equally all around and so will not stay tight for any length of time. These objections have been removed of late years by more experienced design and construction, and, since 1902, hardly a large engine in Europe on superheated steam is not of one form or another of the lift-valve system.

On entering a moderate sized Continental central station of such engines, one appears at first sight to be in a gas-engine power house. The engines appear to be disproportionately long and their valve gear is driven by eccentrics off a lay-shaft, precisely as with large gas engines. There is no overhead piping in sight nor any main throttle valve. There are no valve-stem packing glands discoverable, and the valve stems for a 600 horse-power engine are less than ½ inch in diameter. If one is fortunate enough to see an engine being erected, or open for inspection, the interior will be quite as curious. The admission and exhaust valves are mounted in the cylinder heads, which are machined all over the full diameter of the cylinders; steam enters these heads by ports registering with those in the cylinder casing, which is double, the outer being a steam jacket; and both the cylinder ends and piston heads are as highly polished as the walls of the cylinder itself.

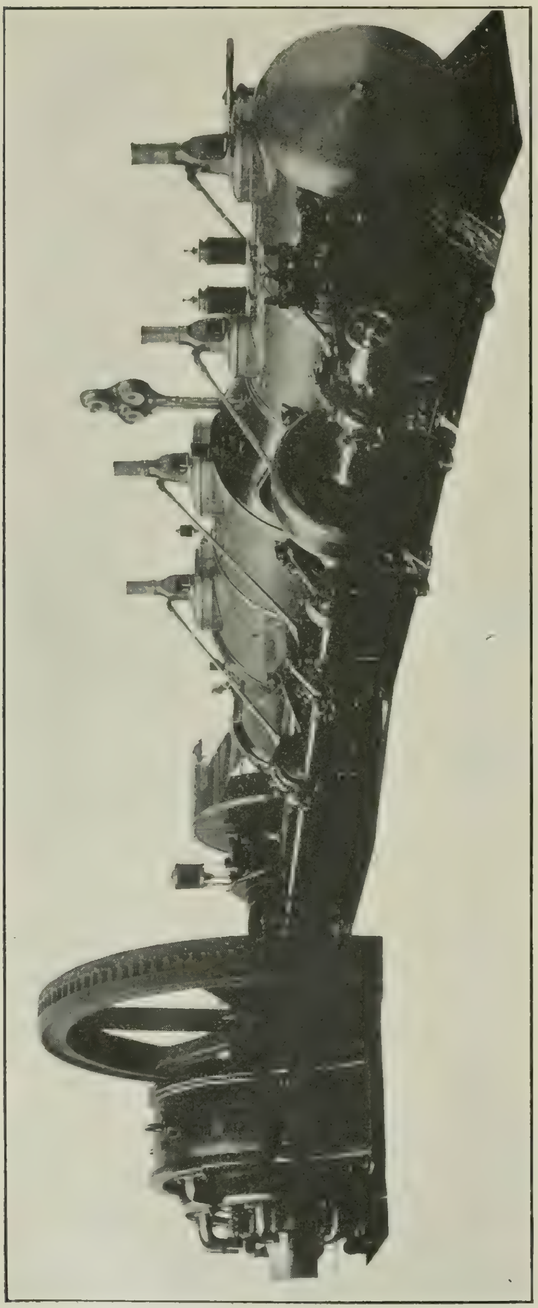
The engines run very quietly and smoothly, with neither click of trip-gear nor snifting of dash-pots, but when they tell one that the steam consumption is between 11 and 12 pounds it is apt to be passed off airily as a mere European exaggeration.

To the American engineer, the first criticism that comes to mind is that all this machine work is very fine, but such an expensively constructed engine would never sell for a moment against his own cheaply designed Corliss trip-gear and four-valve engines. But, if such a criticism were offered to the European engineers, it would probably be met with a query as to the steam consumption of the average American engine. Well, in 300 horse-power sizes, 23 pounds represents good American guarantees on a four-valve engine, and 20 to 17 pounds on a trip-gear. One cannot help thinking that in their minds is running the comment:—"How typically American; to waste so much coal for the sake of building an engine a few dollars cheaper."

But these European steam consumptions are every-day facts. It pays to polish the piston and cylinder heads, because a highly polished surface absorbs much less heat than a rough casting. It pays to jacket both heads and walls of cylinders, because it reduces cylinder condensation. It pays to superheat the steam, because 27 per cent of the steam is otherwise lost in the exhaust, that might have been used in the cylinder.

And, since the ordinary slide-valve and Corliss valves with gland-packed valve stems are not entirely suitable for superheated steam, Europe has gone at the problem in the only logical way and developed a new system of steam distribution called the poppet or ventil gear.

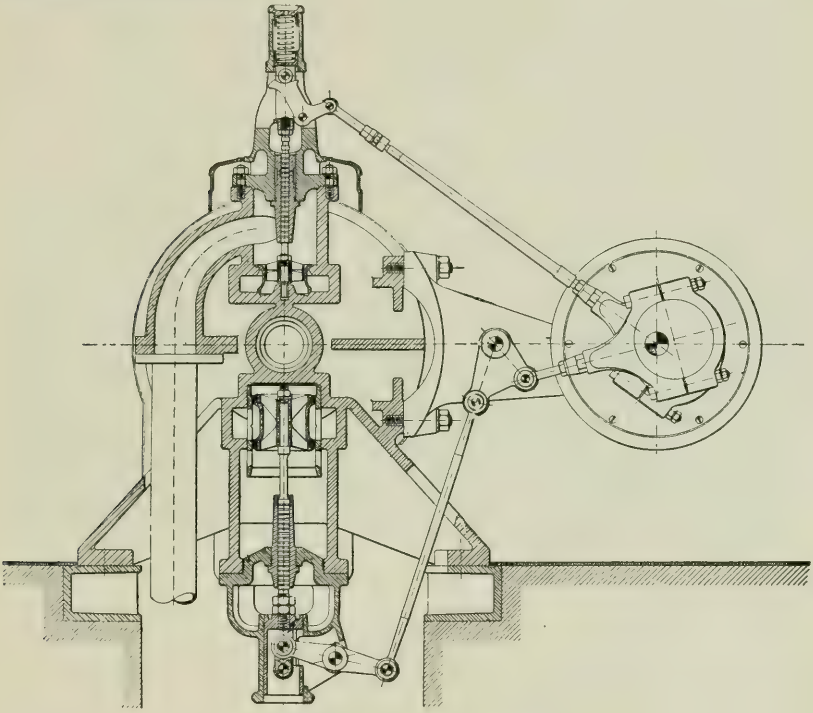
Who builds these engines? Practically every large engine builder in Europe,—Krupp and Augsburg in Germany, Tosi in Italy, Bollinckx in Belgium, Dujardin in France, Brünner in Austria—just to



BOLLINCKX STEAM ENGINE WITH LIFT VALVES.

mention one builder in each country. It is fast becoming the standard installation in Europe, for any proposition not pecularly adapted to steam turbines.

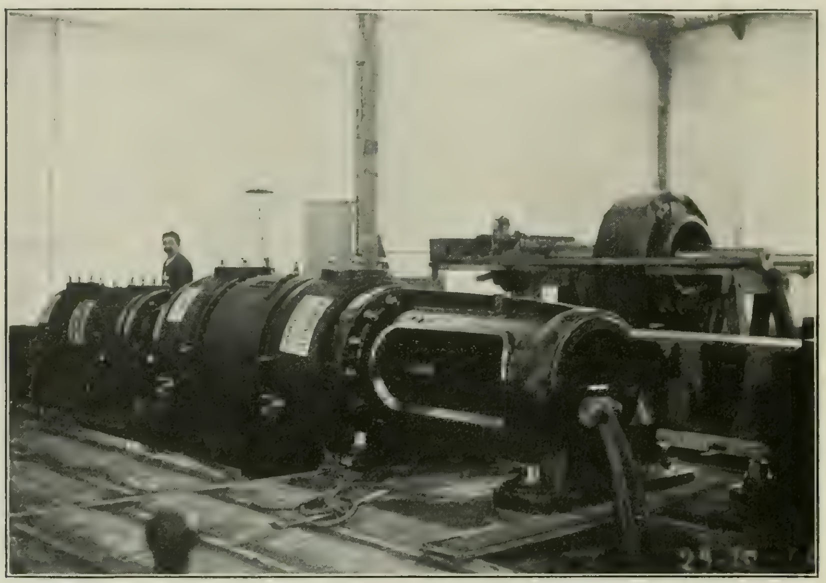
The ventil system is simple enough. A small double-seated balanced poppet-valve, actuated by a cam which is driven by an eccentric on the lay shaft for the admission valves; and either piston or lift valves, link-driven by eccentrics on the lay-shaft, for the exhaust. The valve has no sliding friction, whence it requires no lubrication, and is therefore highly suitable for superheated steam: Being balanced, it takes almost no force to operate, and, as there is no shock or jar, the valve being always under the control of the cam, it requires but a very small stem. The best packing for it has been found to be no packing at all. As will be noted from the section of the valve-gear, the stem is *ground* into the bore of the valve-stem bushing, and labyrinthine rings are cut on the stem which soon fill with oil and condensed steam from the cylinder and are impervious to leakage. Some of the builders provide the stems with a loose steel disc, which condences any wisp of steam that might get through. The construction of the stuffing box is shown on page 197.



SECTION THROUGH VALVE GEAR.

The cam opens the poppet promptly and cuts off practically with the speed of a trip-gear dash-pot, but arrests the ventil ½ millimeter above its seat, whereupon it is gently deposited on the seat. The total lift to develop the full opening of both lips of the ventil is only 12 millimeters for quite a large engine, which compares strikingly with the travel of a piston-valve for the same opening.

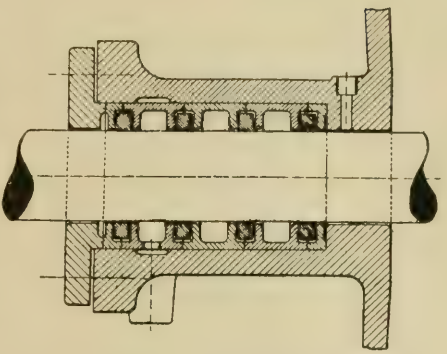
Aside from its advantages in the use of superheated steam, it has the mechanical advantages of doing away with the trips and dash-pots of the Corliss gear, with their frequent adjustments; and of imposing but very little load on the governor, so that the latter can be made light and sensitive, as is desirable for instance in the paralleling of polyphase alternators. Furthermore, the valve is opened to full height instantly by the cam, and remains at full height for a greater or less proportion of the stroke, depending upon the governor, so that you get constant port-opening, and therefore wire-drawing and inexact governing are avoided.



CYLINDER OF LIFT-VALVE OR "VENTIL-GEARED" ENGINE, SHOWING VALVE MOUNTING IN CYLINDER HEAD.

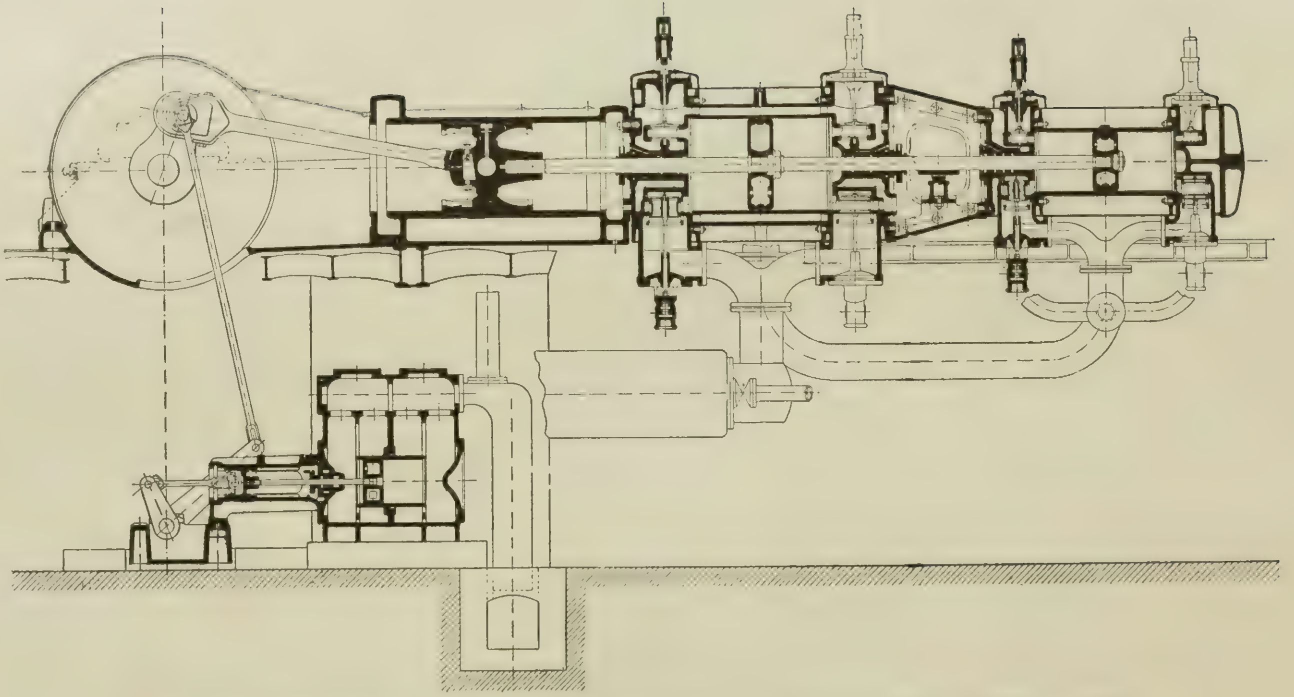
For the exhaust valves the makers vary considerably in preference, some using piston valves and others poppet. The temperature of the exhaust is always low, and there is always plenty of lubrication from the cylinder so that a piston valve can be used without difficulty. The preference for it is mainly because there is a certain amount of dirt and oil impurity in the exhaust, not found in the live steam of the admission, and this dirt is apt to get under the seat of a lift valve and cause it to leak, which possibility is not likely in a piston valve.

Finally, both valves are mounted in the cylinder-head castings, not only to steam-jacket the cylinder ends but to reduce the clearance, because these ventil seats can be placed to open right into the cylinder through wide ports in the heads, thus having less clearance space than any other form of valve gear and permitting the piston virtually to sweep the entire cylinder volume.



STUFFING BOX FOR SUPERHEATED STEAM.

With all large slow-speed steam engines driving polyphase alternators in parallel, some form of inertia governor is essential or otherwise they will be exceedingly prone to "hunt" or over-travel. Change of speed is brought about by an alteration between the load and the driving power. If the load changes, all the various parts of the engine attempt to change speed also, the lighter ones first. But as they are all pinned together by links, pins, and cranks, no part can change any faster than the heaviest moving part, which is usually the flywheel. If the governor also is tied up to this mechanism, as is the ordinary ball governor, it will only alter the driving power simultaneously with the change of speed of the entire engine. This will be too late, particularly with alternators in parallel, so that the entire engine will over-travel and change speed too much in proportion to the change in load. This lack of promptitude in the governor causes the well-known "hunting" so troublesome with alternators in parallel in central stations or with rotary converters in the sub-stations. Now, if there is something on the engine *not* pinned to it but only attached by a spring, this will follow its natural impulse and change speed simultaneously with the change of load, its inertia absorbing part of the power of the spring. This form of governor has been extensively employed in the ventil-geared engines with great success in driving polyphase alternators, so that it is possible to run them in parallel without having to consider the distribution of loads on the engines. In the Belgian engine illustrated the inertia governor takes the form of a flywheel mounted on a sleeve on the lay shaft and controlling the throw of the eccentrics of the high-pressure cylinder admission-valve cams. It also forms a casing for the mechanism of the governor, which consists of two centrifugal masses pivotted to a support fixed on the lay shaft. These are connected by links to the flywheel on one side and on the other to a balancing spring. As soon as a change in speed begins to occur (due to a change in load) the inertia of the flywheel absorbs part of the power of the spring, thus permitting the weights to diverge immediately and allowing the flywheel to



SECTIONAL ELEVATION OF A TANDEM ENGINE, CONDENSING, WITH LIFT VALVES OR "VENTIL GEARS."

gain on the lay shaft. It thus alters the throw of the eccentrics and so changes the admission before the main engine gets a chance to make more than a very slight change in speed. This governor gives an ideal condition for paralleling alternators, since the inertia governor is tied to its engine by the spring in much the same way that two alternators are tied together electrically, so that the variations of the one are lost in the resiliency of the other.

The piston-rod packing used in these engines constitutes a new and interesting advance in that problem. It is here that the Continental builders have chosen to introduce the cylinder lubrication. They have also taken advantage of the fact that the cylinder during the exhaust stroke is under the suction of the vacuum. The packing consists of four cast-iron rings pressing lightly against the rod. The housings for those rings form a series of annular chambers which are filled with the incoming cylinder oil from some such pressure lubricating apparatus as a Mollerup lubricator. The steam during the admission stroke forces its way past the first cast-iron ring in small quantities and into the first annular chamber, possibly into the second. During the exhaust stroke it is condensed and returns into the cylinder along with the lubricating oil. This packing is frictionless and in practice the steam never gets beyond the second annular chamber.

All these Continental engines run at about 125 revolutions per minute for large horizontal central-station and mill work. The ventil-type engines were the only ones exhibited at the Brussels World Exposition this year, every big maker having a specimen of about 500 horse-power on the floor.

But the high-speed engine always has a special field of its own from which it cannot be displaced, and so, to meet the demands for a high-speed ventil-geared engine, the double-ventil system known as the "Lentz" was devised and extensively adopted by German, Belgian and French manufacturers. This system works very well on speeds from 200 up to 400 revolutions per minute and has even been applied recently to torpedo-boat engines of 6,500 horse-power, using superheated steam and thus competing successfully with the steam turbine both in weight and performance.

The Lentz system valve-gear is, in effect, two double-seated balanced poppets with the stems projecting towards each other through their respective stuffing boxes, so that the same cam can act alternately on either stem, thus admitting steam to head and crank ends of the cylinder. A similar pair of poppets perform the same office for the exhaust, while both cams are actuated by the same rock-shaft.

Installation Tested	Dimensions of engine Millimetres H. P. cyl.	L. P. cyl.	Stroke	Steam Pressure Atmospheres	H. P. Developed	Steam Consumption (Sat.) per H. P. hour Kilogram's
Ivan Simonis...... (Verviers)	450	710	900	7.1	200	5.25
Peltzer & Fils.... (Verviers)	760	1150	1500	7.2	690	5.36
Michelin & Co.... (Clermont-Ferrand)	600	940	1200	7.8	315	5.34

STEAM CONSUMPTION OF SOME LIFT-VALVE ENGINES.
Courtesy of H. Bollinckx, Brussels, Belgium.

These valves are placed side-by-side beneath the cylinder, thus making it self-draining, and are driven by an eccentric on the main crankshaft connected by a light rod to the cam rock-shaft. A little study of the shape of the cam will show that it gives an abrupt rise or descent to the ventil, remaining at full open as long as the circular edge of the cam is in contact. At the end of the descent is an easement which seats the ventil without shock. The greater the throw of the eccentric, the longer will be the time when the valve is full-open.

This fact makes quick and accurate governing very easy to obtain. The governor is simply a very light flywheel inertia governor, much lighter than the corresponding Rites inertia governor for a slide-valve engine of the same size, because the poppets take virtually no power to operate. This flywheel governor advances or retards the position of the eccentric with respect to the position of the cam rock-shaft, thus altering its effective throw and varying the time of admission.

This gear is used both on high-speed stationary engines destined to be run with a separate boiler, and on locomobile units, as in the thousands of installations of the firm of Heinrich Lanz. They make a very smooth and quiet-running engine, and tachometer measurements taken by me on all sorts of fluctuating loads show them to be quite as well adapted for parallel operation as American slide-valve high-speed engines, in addition to which they can easily handle superheated steam at 587 degrees F. and 180 pounds boiler pressure, which American high-speed engines can not.

SYSTEMATIC FOUNDRY OPERATION AND FOUNDRY COSTS.

By C. E. Knoeppel.

II. THE PRINCIPAL ELEMENTS OF FOUNDRY ACCOUNTING AND MANAGEMENT.

In a preceding article, inaugurating the present series, Mr. Knoeppel outlined the elements of the foundry problem. His article this month discusses thoroughly the very important question of depreciation.—THE EDITORS.

THE statement was made in the previous series on the above subject, that "results of action vary as knowledge increases or decreases," the moral of which is—*know what is going on.* Any industrial undertaking is operated for profit, by men who do not start out with the definite intention of having the venture eventually prove a failure. They expect to be successful and to make money for themselves and for those who may be associated with them in the business. Theoretically, then, there should be no such thing as failures; but the mere fact that each year adds its number of industrial wrecks to the large number that have preceded them, simply emphasizes the fact that action has been the result of a lack of, or the wrong kind of, knowledge. The simple elements of any business, if analyzed and studied, will show how necessary it is, if success and profit is to be attained, to have the *right* kind of knowledge, furnished in the *right* manner, at the *right* time.

Elements must always be recognized before knowledge can be complete. Mathematics would not be mastered in a thousand years if calculus was the starting point, yet it is possible to go into foundry after foundry and find a most hazy idea as regards what constitutes the elements of the business; and where an element is recognized, a great diversity of opinion as to its correct definition is likely to be met with. The purpose of this paper is therefore to pick out, to define, and to attempt as far as possible to reduce to some sort of standard practice, the principal elements entering into the successful operation and management of the foundry, in order that the many possibilities in the two forces discussed in the previous paper—the "analytical" and the "constructive"—may be used to advantage by the foundry manager.

The business of the foundry is to *make castings* and the elements which go to make up the foundry output or production are:—

1. Castings for sale to the trade or to the company of which the foundry is a part, or to both, which we will term "Commercial Production."

2. Castings for the use of the foundry itself, which we will term "Shop-Use Production."

If we attempt to analyze these elements, we shall find that the first is one that is easily understood, as it includes only such castings as will produce a direct revenue on which a profit or loss is made. The second is made up of several other elements which can be picked out and defined, if consideration is given to the following:

While the definite aim of the foundry management is to make and to sell as much as possible, every foundryman is confronted with the necessity of periodically replacing or renewing or repairing certain parts of his plant and its equipment, which leads us to the statement; in order to produce to advantage, we must *maintain* that which makes our production possible. We have still another consideration. The ambition of every foundryman is constantly to increase his volume of production, and depending upon his success in realizing his ambition, we find that he is forced to add new equipment, to build additions, and in other ways to place himself in position to supply his trade with their requirements. This gives us the thought—to expand so as to produce more, it is necessary to *construct* that which will make a greater production and an increased volume of sales possible. This construction is of two kinds, although this fact is not generally recognized, the distinction being determined by the consideration whether the construction is something *altogether new* or simply *the changing of something that has already existed.* We will term these two kinds, A—New Construction, and B—Reconstruction.

In every foundry it is necessary to do special work for customers, as, for instance, making new patterns, replacing or repairing their patterns, or making special rigging for their work, for which a price is charged—another element which we must consider. Still another is made up of such items as cannot be classed with any of the elements which have just been pointed out, and as consideration will show that such an element could not be classed as a revenue-producing or an asset element, it must be classified as expense. Our division of foundry endeavor, common to all foundries, would therefore be as follows:—

1. Commercial Production.
2. Maintenance.
3. Construction—
    - A New Construction.
    - B Reconstruction.
4. Special Work Chargeable to Customers.
5. Expense.

After the principal elements have been pointed out, the task of next importance is to have them intelligently control the numberless details that are met with in the foundry, which must be switched onto one or more of the five main tracks mentioned. In the South Terminal Station in Boston, there are twenty-eight tracks which are connected with the outer network of tracks by switches, and upon the correctness with which these switches are manipulated by the operators depends the safety of hundreds of passenger trains which enter and leave this station daily. There would be absolutely no excuse for an operator to make the statement that he was not sure which one of the twenty-eight tracks a certain train was to enter upon. Likewise, it is just as necessary, in order to prevent costly mistakes, false impressions, dangerous conclusions, etc., to switch the details that are met with daily onto the right tracks. How little attention has been given to this particular consideration of the subject, however, would be evident to anyone who could have the opportunity of placing together, for comparison, the handling of the details in a hundred foundries. It is safe to say that the variety would be most surprising and would be one means of showing why the everyday foundry competition is so inefficient.

The much discussed topic "depreciation" plays such an important part in the proper understanding of the elementary factors of the foundry business that it was deemed advisable to take up the discussion of this subject somewhat in detail.

Keister, an authority on corporation accounting, defines depreciation as:—

> The actual loss upon assets which are diminishing in value, or an estimated sum charged against gross revenue, which amount is considered sufficient to replace the capital used up or reduced by wear and tear.

L. S. Randolph, in a recent paper in this magazine, defines it as follows:—

> The fall in value from any cause whatever, the essential element being that the machine or structure becomes obsolete.

In other words, the common understanding of the subject seems to be that depreciation is:—

> The provision made to maintain the book value of an item on a level with the diminishing value of the item, due to its usage or other reasons.

It must be an intensely optimistic mind that can see no depreciation in what he possesses. Such minds do exist, for the author was once told by a shrewd manager that there was no such thing as depreciation; that as long as he kept whatever he had in good condition, it was as good as the day he purchased it and therefore worth what had been expended for it. A foundryman, citing the tumbling barrels in his cleaning room as an example, stated that he considered that there was no wear out to them, for whenever staves were broken, he promptly replaced them, which made the barrels as serviceable as ever. Excellent viewpoints, both of them, but in error just the same.

Let us outline a case which will serve as an illustration. Assume for instance that a horse had been purchased for $350 and for a period of years did all that any horse could do, during which time he was fed regularly, shod when necessary, occasionally received a "doctoring up." Eventually, however, on account of the age of the horse, disease, or other reasons, it has to be sold, $50 being all that it will bring, and to take its place another horse has to be purchased, for which a price of $250 is paid. Assuming the consideration had been that the value of the horse did not diminish, in which case no depreciation charge was ever entered, and we find in our assets an item of $350 year in and year out. Finally, when the horse is sold and the new one purchased, we credit the assets for the salvage of $50, but charge it with the $250 expended for the new horse, so that the account stands—

Old horse	$350.00
New horse	250.00
Total	$600.00
Received for old horse	50.00
Balance in account	$550.00
Value of new horse	250.00
Difference	$300.00

Here we have $300 in the assets account for which there is no value whatever. The only thing to do is to write the amount into profit and loss and the executive can say to his stockholders:

> Gentlemen.—I had to sell our old horse and purchase a new one. After just paying $250 for the new horse, I find the value of the old horse still in our assets, so will have to carry it into profit and loss—hence you will have to go into your own pockets this year to pay for the new horse and in addition stand the difference between the value of the old horse less the salvage and the value of the new horse.

Such an explanation would certainly not appeal to the stockholders, in fact their reply would probably be:

> You should not have allowed this replacement and loss to come out of this year. If the decreasing value of the horse had been offset by a depreciation charge and this amount absorbed yearly by our cost of production, our customers would have paid for it the same as they pay for the labor and material which enters into their product. If this had been done, not only would our profit have been about the same during the years we have had the horse, but when the time came to purchase the new one, there would have been enough in reserve to take care of the purchase without calling upon us to do so.

From this statement, two conclusions are forthcoming:—

1. The customers, not the stockholders, should have paid for the horse.

2. By making "cost of production" absorb the cost of the old horse, less the salvage, the expenditure would have been returned to the business.

A study of this leads to the conviction that one phase of the subject which has never received the proper amount of consideration is the fact that *regardless of all questions of replacements, diminishing values, wear and tear and reserves, whatever is produced for commercial use should absorb all that enters into making that production possible,* whether it is the wages paid to the workmen or the cost of the machinery; expenditures for materials used, or what has been spent for erecting buildings. In other words, whatever is produced uses, in some form or other, the various items in the list of assets and should be assessed with its proportion of the cost of these items. The wages paid the driver of the horse we were just discussing is entered every month against the production of the month. Why not some part of the cost of the horse? If the $65 per month paid to the driver should be left out of the consideration, through an error, what a stir would be raised because of the carelessness of some clerk! But what is said if the cost of the horse stays buried in the assets month in and month out?

A foundryman purchases a moulding machine for $1,000, which he promptly proceeds to charge to his assets. He engages a moulder to operate this machine, and immediately the machine and man become a unit in turning out production. The foundryman charges the wages paid the moulder against the production of the machine, being very careful that the distribution of the labor is as correct as possible. He may be of the opinion, as many foundrymen are, that there is very little depreciation in a foundry—he may believe there is none at all; and as a result, a very small charge for depreciation is entered against the production of man and machine—perhaps nothing. If it is logical to charge wages against the production, it is just as logical to make this production bear its share of the cost of the machine. The only difference existing is the fact that the workman receives his wages weekly at so much per day while *the machine is paid for in advance.*

The analogy existing between man and machine is worthy of mention. Assuming for purposes of comparison that a man contracts, with a concern or its successors, to give it his services for a period of ten years, at $1,500 per year, the entire sum to be paid upon signing the contract, which provides that in case the man is able to continue on for an additional five years, he is to do so for no extra compensation, the man in turn being guaranteed against deductions for sickness, vacations, etc., the concern to waive all claim to any part of the $15,000 in case of the death of the man. What difference is there in the condition when a machine tool is purchased? The builders of the tool contract with the concern wanting the tool, to give it the service of the machine for $15,000, their estimate being that the machine will last ten years with ordinary usage. If the machine lasts fifteen years, no extra amount is forthcoming to the tool builder. If the tool is out of commission for repairs or because there is no work, the concern gets nothing from the tool builder. If the machine wears out before the stipulated ten years, the concern loses, although there would be some salvage in the disposition of the discarded machine, which would not be the case should the workman die—the only point where the comparison does not hold.

The concern might feel justified in taking the stand that there was little or no depreciation as far as the machine was concerned, but what a difference there would be as regards the man. Not one of the 120 months would pass without a charge of $125 being assessed against the business for the month. If the nature of the work was such as to admit of its being distributed to some specific line of production, this would be done; if this were not possible, then it would go into the general expense of conducting the business, but it would be included without question, for would not the contention be that the amount expended for the man is a part of the direct or indirect cost of production? Most assuredly it would, and rightly so.

Three things could happen to the man—

1.—He might be off sick from time to time, occasionally going away on a vacation (corresponding to a machine being down for repairs or not in operation because of lack of work).

2.—He might die before the ten years are up (corresponding to a machine being discarded before it has given its full measure of usefulness).

3.—He might work for the ten years and then continue for a few years longer (corresponding to the machine lasting longer than anticipated).

As regards No. 1, it is evident that the charge must be made against general expense. In the case No. 2, if the man dies before the stipulated time, there are only two courses open to the concern.

A.—Write the undistributed portion into profit and loss, thereby closing the transaction.

B.—Allow the undistributed portion to be absorbed, year by year, according to the schedule originally mapped out.

In case No. 3, we have the opposite of case No. 2—the man working longer than was expected. As the $15,000 has already been absorbed by the ten years during which he worked, there remains nothing further to absorb, consequently the services of the man from the ten years until he stops are a clear gain to the company.

Substituting buildings, machinery, and general equipment for the man cited in the illustration, we are bound to reach the same conclusions, and, while the comparison is contrary to all reason, it was used because a person interested would see, in comparing man with machine, that the machine would have to be handled in the same manner as the man.

An opposite viewpoint is equally interesting. If the concern could contract for the buildings, all machinery and equipment, etc., on the basis of monthly payments, for the period of years corresponding to the life of the items (assets on a man basis), it is obvious that *there would be no assets at all for the concern would own nothing until full payments had been made.* The procedure would be most simple. The cost of production of each month would absorb the monthly payments on plant, the same as it would absorb wages, cost of material, and the general expenses. When all payments had been made and the concern owned everything free and clear, it would be found that the production had paid for everything. If the concern had started out with capital to purchase their plant but had contracted as above outlined, it would also be found that the original capital was intact, as during the years, assuming the business to be profitable, the customers had been paying enough to take care of the cost of the production *which included the charges for plant, plus a profit for the stockholders.*

From these two illustrations—opposite in their nature—it is evident that there is such a thing as depreciation, and that, as the cases cited made no reference to reserve for replacements, diminishing values, etc., it would seem logical to make the assertion that these considerations are after all *only side issues* instead of *principal elements* of the subject that have so long been considered as being the reasons why it was necessary to figure depreciation.

I get my friends to advance me enough money to buy land, erect buildings, install machinery, with the view of conducting a foundry business. I solicit business, get orders which I proceed to fill, charging labor, material, expenses against my monthly productions. My friends may know nothing of the foundry business; they may know little about depreciation, diminishing values, reserve for replacements, etc., *but they do know that they want the business to earn what was invested;* and how can a business earn the investment if a proportionate amount is not a part of my production costs? If I fail to do this, I give my customers the benefit of money invested in my business which they are not entitled to, for when the time comes for buildings to be replaced, new machinery installed in place of that which has worn out, etc., I find no funds on hand to do the work with, without going to my friends to "stake" me a second time. If I sell my plant, it would not, on account of its run-down condition, bring anything like what was put into it originally, hence my friends would lose their investment, or at least the greater part of it. If, however, I had added a proportionate amount of my friends' investment to my cost of production, for which my customers would have paid, I would have invested in good securities funds with which to do my replacing; or I could sell out, and return to my friends the money they invested *plus* their share of the sale of the plant.

Production should do more than absorb what has been expended for material, wages and expenses. It should absorb the cost of the real estate, the buildings, the machinery, etc., and until it has done this, the cost of what we produce cannot cover what we have actually expended. If I pay $1,000 for a moulding machine and it lasts ten years, and I neglect to charge $100 per year for these ten years to my costs of production, then I am out $1,000—and there is no other way of looking at it. Even if the machine lasts twenty years I do not get back my $1,000, for if my customers fail to pay me for it, who will? The same with everything else, from an expensive building to the horse in the stable.

My theory of depreciation is therefore:—

"The absorption by production of all capital investments, in proportion to the use of this investment entering into making this production possible, and the consequent insurance of a return to the business of the initial expenditure."

This can easily be seen to take care of wear and tear due to usage, diminished value which is the undistributed portion of the costs assessable to future production, reserve for replacements which is the returning to the business what originally was a capital outlay.

As regards the method of figuring depreciation, consideration should be given to the following:—

1.—The estimated life of the unit must be established.

2.—The units must be classified according to those which can be assessed—

A.—Against specific production, as for instance a moulding machine.

B.—Against classes of production, as for instance a building for a certain class of production or the crane in this building.

C.—Against total production, as for instance a crane serving the whole shop or the cupola, fan, charging appliances, etc.

3.—For 2A, a rate per hour should be ascertained which can be charged to specific production when the unit is in use, or to general expense when idle. For 2B and 2C, a rate per month can be established which can be assessed according to the facts in the case.

In establishing these rates we can proceed as follows:—Let

M—Estimated life of the unit in months.

H—Estimated life of the unit in hours.

C—Cost of the unit.

I—Cost of installing the unit.

I_1—Interest on the cost of the unit.

S—Possible salvage upon being declared obsolete.

RH—Rate of depreciation per hour.

RM—Rate of depreciation per month.

Using these symbols, we may then formulate the monthly and hourly depreciation rates thus:

Rule 1.

$$\frac{(C + I + I_1) - S}{M} = RM$$

Rule 2.

$$\frac{(C + I + I_1) - S}{H} = RH$$

Regarding the recording of depreciation charges, a first thought would be that the clerical labor involved in keeping an accurate record of depreciation renders a careful accounting impractical. To keep properly informed as to existing conditions; to have production costs absorb capital charges equitably, it is necessary to keep some track of the items; and while the work may seem unnecessary and like too much "red tape," it will be found profitable. The card illustrated on page 211 would serve as an excellent means of keeping track of values, the reverse side being ruled to show the maintenance cost, date, order number, and the value of repairs. Reserve accounts should be opened for depreciation charges, which should be classified according to

Reserve for Buildings and Real Estate.
Reserve for Plant Equipment.
Reserve for Power and Transmission Machinery.
Reserve for Flasks.
Reserve for Patterns and Drawings.
Reserve for Stable Equipment.
Reserve for Office Equipment.

To these should be credited the amounts charged expense for the depreciation, as shown by a recapitulation of the cards illustrated. In this manner the original values of the asset items are left intact, being offset by these credits to the reserve accounts.

In closing this paper, a few words should be said with further reference to a procedure for asset items declared obsolete before their estimated life, or lasting longer than anticipated. As was stated, two courses are open; either to close the transaction or to allow it to work itself out. It would seem that the former would be the best method of procedure. A contrary opinion by H. C. Bentley, C. P. A., an authority on accounting practice, is as follows:—

Department							Account			
No.		Name of Unit						Estimated Life		
Made by Purchased from				Date			Order No.		Rate of Depreciation	
Date Installed			Original Cost			Interest		Installation		Total Cost
		Betterments						Depreciation		
Date	OrderNo.	Item	Value	Total	Date	Amount	Balance	Date	Amount	Balance

FORM FOR RECORD OF DEPRECIATION.

> If ten per centum per annum of machinery and equipment is reserved for depreciation and a machine is replaced three years from the date purchased, it would be theoretically correct to charge the reserve account with only thirty per centum of its cost, as this is the amount reserve has been credited on account of this particular machine. This would necessitate charging "Surplus" with the remaining seventy per centum. It it not advisable to put this theory into effect, however, as some machines will last much longer than the ten years while others must be replaced in much less time than ten years. It thus follows that such inconsistencies adjust themselves in the long run, on a basis that is quite as equitable as if an elaborate method were operated with a view of securing more accurate results.

In the illustration cited by Bentley, $7,000 would be the loss in the year in which the transaction was closed, if the machine had cost $10,000. Assume for example that another machine, with an estimated life of ten years and costing $10,000, should last fifteen years. At the end of the ten years, the $10,000 would stand as a credit to the reserve for depreciation, with five years ahead of the machine. This would mean that the account should have been credited with $666.67 yearly or $6,667 in the ten years, leaving $3,333 to be absorbed by the years to come. We have the $10,000 in reserve, however—too much under the conditions. If, then, we open a "Values Adjustment Account" and credit it with this $3,333, the value on hand, giving this value to reserve for depreciation through a charge entry, we *reduce* the depreciation credit to $6,667, the amount it should be. We simply transfer part of the reserve credit, *corresponding to the gain to the company,* from one account to another. Crediting assets and charging "Values Adjustment Account" for the $7,000 loss, leaves an adjustment of $3,667 which we would credit to this account and charge to profit and loss.

To a concern desiring to get at the truth of things this would be the proper procedure, as in this way we recover, on items lasting longer than anticipated, a portion of the values in depreciation reserves which can be used to assist in taking care of the losses due to units declared obsolete before the expiration of their estimated life.

TEMPORARY WHARF, AGUA DULCE, NOW REPLACED BY CONCRETE AND STEEL. PROVINCE OF COCLÉ.

THE DEVELOPMENT OF PANAMA BY PUBLIC ROADS.

By Edward Perry.

The occupation and productive stimulation of new regions, as suggested in the introduction to Mr. Wilson's article elsewhere in this issue, is always interesting to an industrial nation. The development of Panama should have special significance for the manufactures and commerce of the United States.—THE EDITORS.

AS a whole Panama is practically a long, bent and broken range of hills of no great height—the higher of them, however, reaching from 5,000 to over 7,500 feet above the level of the sea. From the border line of the republic of Colombia the new republic runs westward some 430 miles to Costa Rica. In its widest part it is close to 122 miles on a line running from the Caribbean Sea due south to the Pacific; and a line running due north from the Bay of Panama to the San Blas Gulf would be little or no more than 33 miles long from ocean to ocean.

On the north coast are the city of Colon and the village of Bocas del Toro, with a few widely separated hamlets where short streams flow over sandy, shallow and shifting bars into the sea. On the south side of the country swift streams run from the hills near by, to empty into estuaries or directly into the Pacific. In these rivers, estuaries, and bays steamers, schooners, and sloops—many of the latter mere

WHERE RIVER AND ROAD TRANSPORTATION MEET.
Landing at Barranco Colorado, Rio San Pablo, on the road to Sona, Province of Veraguas.

dugout canoes—make fast to the banks and put ashore freight and passengers, and take on board produce and other passengers for Panama city, which is the greatest of all the markets in the country.

Beginning at the eightieth degree of longitude and extending to 81 degrees west, and from 7 degrees 13 minutes north to 8 degrees north, is a peninsula which has a coast line of not far from 200 miles. On the eastern coast are a number of rivers, all short and some of them used by small craft. On the southern shore are not so many streams, but on the west a good number flow into the Gulf of Montijo, and afford good harbors for vessels of light draft. On this peninsula are quite a number of villages and towns of 200 to 5,000 people. Gold, copper, and iron are mined on this peninsula, and agriculture is somewhat developed. The peninsula is hilly, and has a fair number of cart roads, some of which are now being improved.

Bocas del Toro is the westernmost province of this republic. It has one dominant industry—that of banana growing. In extent and value this exceeds any other one agricultural industry in the country, if it does not equal in value all other branches of agriculture of Panama. South of the province of Bocas del Toro is that of Chiriqui, with a coast line of fully 120 miles along the Pacific, not counting the shoreline of a number of bays and large estuaries, all of them protected by islands from every gale that blows.

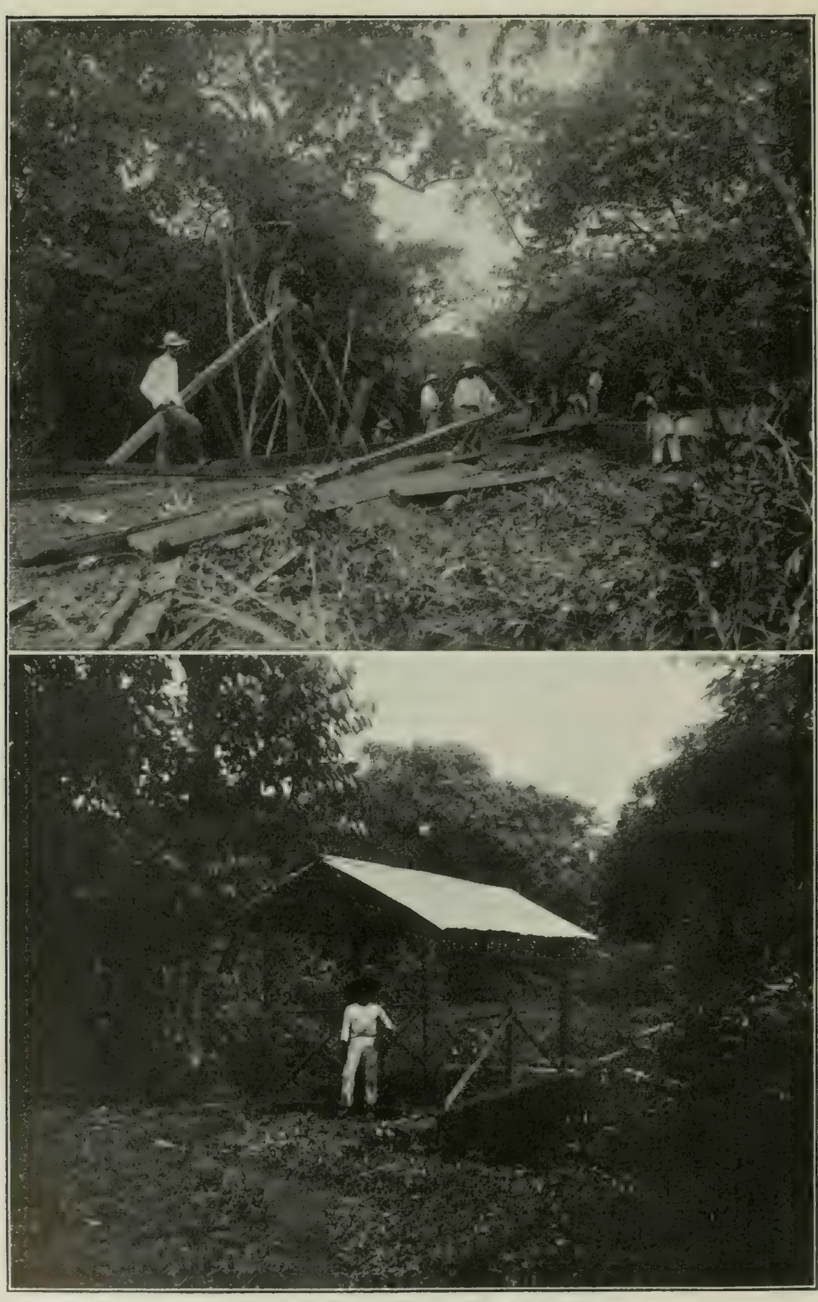
Chiriqui has as much plain or savanna land, perhaps, as may be found in any other two of the provinces, if not indeed as much as is in all the rest of the land. For this reason stock growing flourished there long ago, as it does now, and agriculture had a start. Today a number of coffee estates, a few canefields and other farms, some of them owned by men of northern birth, give support to towns of size. David, capital of the province, is credited with a population of more than 10,000.

Naturally, such roads as are in this republic ran beside the streams, from the landings near the sea up among the fertile hills. On the bottoms and hillsides nearer the ocean the valleys are, of course, wider than those higher up, more thickly occupied, and better developed. Farther up, the hills covered by the mould made by ages of falling vegetation show here and there the home of a farmer, where a thousand farms might well be made. Here grow bananas and beans, cacao and cassava, rice and sugarcane, oranges and mangoes, papayas and pineapples, and many another fruit and crop which might be made far more profitable to the grower and to the nation, if the cost of carriage to market did not equal the selling value in that market. Yet prices of farm products are extremely high in the city of Panama and along the Canal Zone, where more than 52,000 people working for the Isthmian Canal Commission are ready to buy food of this country, but cannot afford to do it, because bad roads make the cost too great.

Last year the Republic of Panama imported, not for people on the Canal Zone but to supply her own people, foods valued at $2,441,389. These foods cost retailers probably more than double the valuation quoted; and most of them, and substitutes for all of them, might better have been grown at home.

Panama has been under control by white men for four hundred years, yet had little or no chance to progress before she became a sovereign nation, a little more than six years ago. Since her declaration of independence she has caused the establishment of a transportation system that gives improved facilities to coastwise traffic, and so has helped greatly to develop business in districts near the natural and the improved ports. That coasting trade is now well able to care for itself, and to promote further development of the country it reaches.

This was easily and quickly done. To help yet more, the Government began to realign old roads, and to lay out new; to grade, drain,



PANAMA ROAD BRIDGES, OLD AND NEW.
Below is shown an old covered bridge on the pack trail between Santiago and San Francisco, Province of Veraguas. Above is a view of the work of demolishing an old bridge over a stream in the same province, for the purpose of replacing it by a concrete structure.

and surface these highways, and to build bridges where fords and ferries had for centuries to some small extent served the people. The roads were in few places better than rough earth roads, muddy in many places during eight months of the year, rutted and rough at all other times. They ran into pack-trails which became mere foot paths higher among the fertile hills. Often the fords were difficult, dangerous, or even impassable for days and sometimes weeks at a time. No agriculture could thrive under such conditions.

Panama needed none to tell her of the deadening effects of bad roads, particularly upon agriculture. If there is any one thing about which she is more determined than about any other, it is to make her roads good as quickly and as completely as she can, that people may be led to come and turn into forms useful to mankind the natural riches of her soil. Last year Panama appropriated $1,297,111.65 for the uses of the Secretaria de Fomento (Department of Interior), with the understanding that a large part of that amount would be spent for improvement of the public highways. During the year $660,946.65 only was spent, the Secretary of the Interior having found it difficult to get a dollar's worth of good results for every dollar spent for the work. It was by no means easy to lay out large sums to advantage before the work and the working forces could be well organized. As first assistant engineer the Secretary, Señor José E. Lefebre, now has R. M. Arango, C. E., formerly of the Isthmian Canal, and the work is going ahead rapidly, although the rainy season is now on.

When Panama became a republic there were no accurate records of the mileage of roads, nor of the number, age, or condition of her bridges. All these data were to be gathered at first hand, by surveys in the field. Her count of roads and bridges, from 1904 to 1908 was as follows:

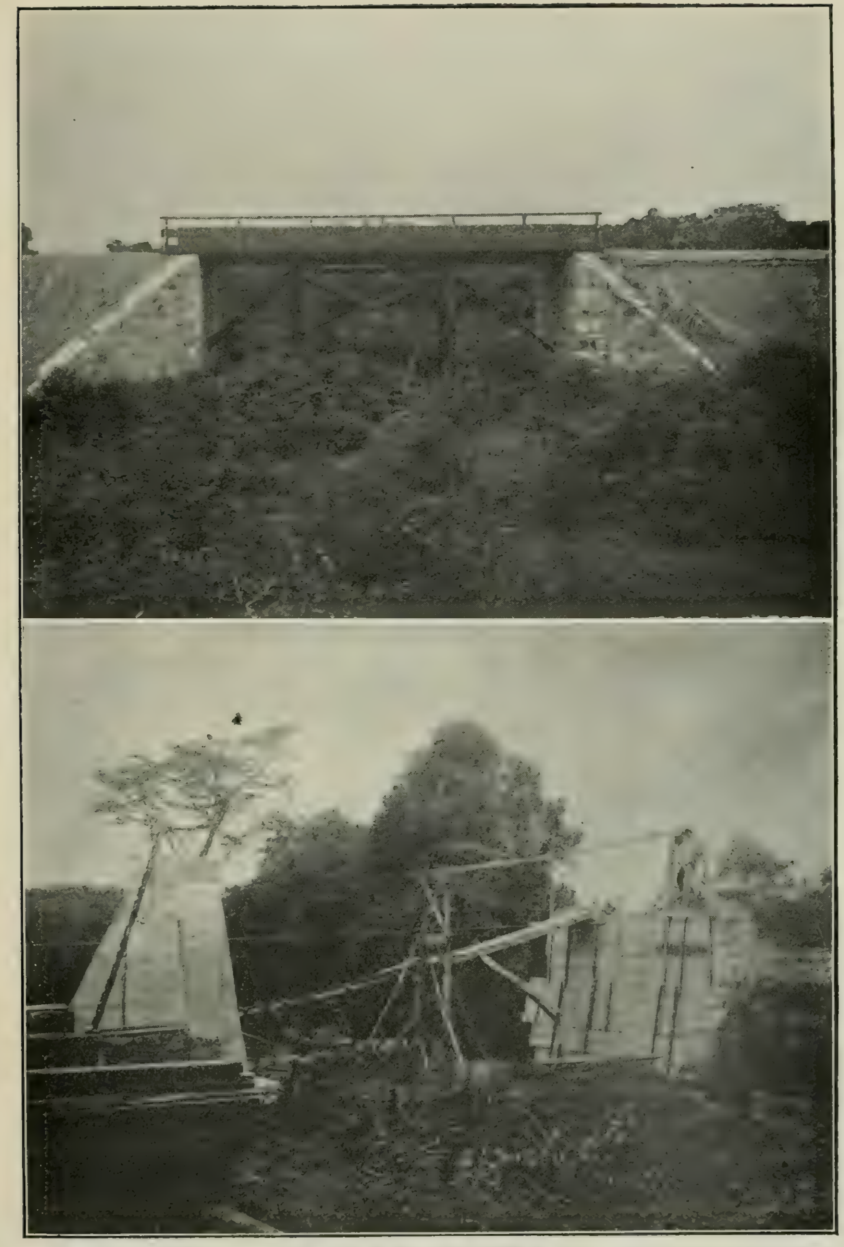
Provinces.	Mileage.	Bridges.	Values.
Coclé	29.80	8	$126,600
Chiriqui	326.79	34	113,035
Los Santos	45.88	10	58,796
Veraguas	56.92	9	60,300
Totals	459.39	61	$358,731

At first the Panamaños, like people of the United States, showed little faith in the value of good roads. They waited to be shown that one could haul on a good road five times as much at a time as he could carry over the roads to which all his people had always been accustomed. Improvements which were to benefit them vastly had often been promised in the old days, and had never come. Moreover, these people naturally argued that even if new roadbeds should be made they would be of little value so long as the crossing of the streams would be as of old. Therefore few of the owners of property along the lines of proposed improvements were willing to help the work.

TYPE OF SMALL CULVERT, PROVINCE OF VERAGUAS.

But the Secretary of Interior met this condition successfully by building massive culverts and bridges of masonry and of reinforced concrete, before doing much work on the roadbeds between. Then those who would use those roads were quick to see that thorough and lasting improvement would be made and owners along these roads were more than ready to help the work, as most Spanish-Americans are quick to understand and to adopt real improvements.

In all the regions in Panama where road improvement has fairly begun, the people appear eager to help drive this work as fast and as far as means can be provided for doing it. The situation is much as it was in the States, a few years ago, when persistent hammering on this theme of good roads, diligent labor by newspapers and periodicals, by civil engineers, by highway commissioners and commissions, by governors of powerful States, by members of Congress and other men of much influence, roused the people to demand appropriations of the money of the people for this most profitable of investments for the people. But in this young republic of Panama, three or four years has served to do a work which in the States required a quarter of a century.



ROAD BRIDGES IN PANAMA.

Above, a new wooden bridge with stone abutments, on the road between the landing and the town of Agua Dulce, Province of Coclé. Below, concrete abutments for a new bridge between Puerto Mutis and Santiago, Province of Veraguas

This Government is now surveying lines for a railroad which will, in two or three years from this, extend from the Isthmian Canal westward to the city of David, capital of the Province of Chiriqui, and within a few miles of the boundary of Costa Rica. This road will intersect many highways between the Pacific shore and the hills. Naturally, the railroad will be kept above the level of the coastal plains, perhaps well up the hillsides, because there the streams have banks of durable materials, their channels are so steep that floods cannot rise enough to damage the bridges greatly, nor will roadbeds often be flooded.

Those whose places are below this railroad will be able to choose between a short haul up grade to get quick carriage to market, and a haul down grade to a shipping point on the water. At worst the haul cannot be long, for the distance from the railroad to the crest of the highest hill in all that part of the country, cannot be more than a few miles. The average haul to the railroad may be little if any more than four or five miles. The country through which this national railroad, with its many feeders, will lie is naturally of great fertility. It can produce nearly all things grown in northern lands, and all which the tropics can give in the way of harvests.

For four hundred years this country has been under the control of European races; yet it never had a chance to progress in any substantial way before the year 1903, and much of the time since

A ROAD FILL IN A MANGROVE SWAMP, NEAR THE RIVER LANDING OF AGUA DULCE, PROVINCE OF COCLÉ.

NEW ROAD FROM THE LANDING OF AGUA DULCE TO THE TOWN OF COCLÉ.

has been given to learning where improvements would better be done, and what should be done. The present administration is a unit in determination so to use the money Panama has to bring profitable returns, and not to spend it on the mere work of administering the affairs of the nation. The members of this administration agree, without a dissenting word, that agriculture is the first and most urgent need of the country, as it will be its only permanent, secure, and most profitable industry—almost its only sure salvation from disaster when the Isthmian Canal shall be completed and the fifty thousand now working there shall seek other occupation.

The purpose of the Government has been from the beginning, and is now emphatically, to promote agriculture in the ways which shall be best for those who will make farms there; to encourage the firm establishment of a multitude of small farms, such as exist in France, and to discourage the holding of large tracts to the exclusion of thousands of diligent, frugal people who would give that stability and peacefulness which are necessary to lasting prosperity.

To this end Panama offers to each person who wishes it a lot of fifty hectares (247 acres), for $50, or a minute fraction more than 20 cents an acre. If one takes 200 hectares the price will be $55, and if 1,000 hectares the charge will be 95 cents per hectare; 10,000 hectares would cost $5.45 per hectare, and 20,000 hectares would come to $209,000, or $8.46 per acre. Half of the price may

CITY STREETS, TOWN OF BOCAS DEL TORO, PANAMA.
The paving material is coral, much like the coquina of Florida. The municipal buildings are shown in the background of the lower picture.

be paid, with interest at 6 per cent, at the end of a year from the payment of the first half.

Improved wagon roads, the new national railroad, and the Panama canal, will give to her farmers quick and easy transportation to the great markets, at relatively small cost. The canal itself, when the fleets of the world shall be using it, will be a profitable market for much fresh food, and such products can even now be sent by water to all parts of the Pacific shore.

POWER REQUIRED FOR ROLLING STEEL.

By J. A. Knesche.

The data presented in Mr. Knesche's two articles, the first of which was published in our October issue, are the fruit of valuable original investigations. His results and his discussion of them are of great interest and importance to rolling-mill designers and rolling-mill men and to manufacturers of rolling-mill machinery. To give suitable space and form to the figures for permanent reference, the tables are introduced as folding inserts facing page 224, and the formulæ are placed by themselves on this page, so that they may be consulted while the tables are also under the reader's eye.—THE EDITORS.

IN the introduction to the first part of this study, published in the preceding number of THE ENGINEERING MAGAZINE, it was explained that the tests herein discussed were made during 1907, and involved a considerable outlay of money and time in the investigation of the power required to roll steel. In last month's installment the method of testing and the apparatus used were fully described. It remains now in conclusion to present the results of the tests, to analyze them, and to deduce the conclusions established by the experiments.

DISCUSSION OF THE TESTS.

In order to obtain accurate results it is of the utmost importance that correct measurements be obtained of width and height of the steel after each pass. This of course is very difficult in some mills where tests must be made under the usual operating mill conditions. Anyone who has closely watched the process of rolling an ingot in a reversing blooming mill knows from observation that the steel does not always fill the roll-pass, nor is this necessary so far as the proper operation of the mill is concerned. But since in nearly all cases when working up the test the width of the steel is taken from the drawing of the rolls, and the height of the pass from the position of the rolls as shown by the position-indicator of the mill, it is evident that serious errors must be introduced if these dimensions thus obtained are used in arriving at the cross-sectional area. Figure 13 makes this clear. Suppose a 22 by 22 inch ingot receives five passes in C; after the fifth pass it has been reduced to say 12 by 16 inch and it is then entered into pass A. If the steel is edged before entering A, the height of the last pass in C becomes the width of the first pass in A, and since the height in pass A can be determined from the position

RESULTS OF THE TESTS.

In Tables 1, 2, 3, 4 and 5 are given some of the results of my tests, these results having been obtained by the formulæ given below.

Column 1. Direct measurement as described.
" 2. Width x height.
" 3&4. $\dfrac{\text{Billet volume.}}{\text{Column 2.}}$
" 5. $\dfrac{\text{Area of preceding pass — area of pass in question.}}{\text{Area of preceding pass.}}$
" 6. Average foot-pounds of work done for the pass as shown by indicator diagrams.
" 7. Average foot-pounds of work done for interval between passes as shown by indicator diagram.
" 8. Pass plus preceding interval.
" 9. $\dfrac{w_f\,[V^2 \text{ beginning of pass} - V^2 \text{ end of pass}]}{64.32}$
" 10. $\dfrac{w_f\,[V^2 \text{ beginning of interval} - V^2 \text{ end of interval}]}{64.32}$
" 11. $\dfrac{w_f\,[V^2 \text{ end of accelerating period} - V^2 \text{ begin. of pass}]}{64.32}$
" 12. $\dfrac{w_f\,[V^2 \text{ end of accelerating period} - V^2 \text{ begin. of interv.}]}{64.32}$
" 13. Column 6 + Column 9 or — Column 11.
" 14. Column 7 + Column 10.
" 15. $\dfrac{\text{Column 13} - [\text{Friction load I. H. P.} \times 550 \times \text{Column 21}]}{[\text{Area preceding Pass} - \text{Area present pass}] \times \text{Column 3 \& 4.}}$
" 16. $\dfrac{\text{Column 6}}{550 \times \text{Column 21.}}$
" 17. $\dfrac{\text{Column 7}}{550 \times \text{Column 22.}}$
" 18. $\dfrac{\text{Column. 8.}}{550 \times (\text{Column 21} + \text{Column 22 preceding})}$
" 19. $\dfrac{\text{Column 13.}}{550 \times \text{Column 21}}$
" 20. $\dfrac{\text{Column 14.}}{550 \times \text{Column 22.}}$
" 21. Chronograph records.
" 22. Chronograph records.
" 23. $\dfrac{60}{\text{Time in seconds of one revolution just before pass.}}$
" 23. $\dfrac{60}{\text{Time in seconds of one revolution at end of pass.}}$

TABLE 1.

Giving Data of Test Conducted on 36 x 48 Inch Single, Non-Condensing Rolling-Mill Engine. Fly-Wheel Diameter—20 Feet. Fly-Wheel Rim - 18 1/16 x 12 7/16 Inches. Weight of Fly-Wheel Arms—14,700 Pounds. 4 [illegible] 3 [illegible] 23 1/16 Inch. Billet Rolled to .122 x 4 9/32 Inch x 63.75 Foot Plate.

DATA CALCULATED FROM INDICATOR AND SPEED DIAGRAMS AND FLY-WHEEL DATA.

Pass No.	Piece.					Work Done. By Cylinder.			By Fly-Wheel.		On Fly-Wheel		Actual Total. Including Friction Load.		Constant "C."	Average I.H.P.			Actual H.P.				[illegible]	
	Section. Inches. 1	Area. Sq In. 2	Length. Ft. 3	Length. Ins. 4	Approx. Reduction. Per Cent. 5	During Pass Foot Pounds. 6	Between Passes. Foot Pounds. 7	Total. Foot Pounds. 8	During Pass. Foot Pounds. 9	Between Passes. Foot Pounds. 10	During Pass. Foot Pounds. 11	Between Passes. Foot Pounds. 12	On Billet During Pass. Foot Pounds. 13	Between Passes. Foot Pounds. 14	Work Done on Each Square Inch of Reduction of Section Per Ft. L'gth of Piece Foot Pounds. 15	During Pass 16	Between Passes. 17	Total. 18	During Pass 19	Between Passes 20	Duration of Pass Seconds 21	Time Between Passes Seconds 22	[illegible] Pass 23	Pass. 24
1	4.148 x 2.754	11.423	2	11.00	33.74	48,407	....	48,407	93,562	....	....	....	141,969	....	5,700	158.76	......	158.76	465.93	....	.55	....	71.[illegible]	7[illegible]
	....	.....	..	.....	.....	....	611,377	....	....	....	....	238,023	....	611,377	.....	....	181.70	......	...	151	.	7.36		
2	4.140 x 1.816	7.518	4	5.25	34.18	48,376	....	659,753	46,706	....	....	....	195,082	....	8,200	130.44	......	170.61	525.47	..	.67		72.[illegible]	7[illegible]
	....	.....	..	.....	.....	....	617,695	....	....	....	....	264,220	....	617,695	.....	.. ..	165.50	......	....	136.5		8.22		
3	4.156 x .785	3.262	10	2.50	56.61	327,719	....	945,414	728,291	....	....	....	1,056,010	....	21,800	445.55	......	211.77	1431.78	....	1.34	..	74.7[illegible]	[illegible]
	....	.....	..	.....	.....	....	657,100	....	....	....	....	916,912	....	657,100	.....	....	481.99	......	.....	353		3.48		
4	4.180 x .3623	1.514	22	1.25	53.58	227,957	....	885,057	697,502	....	....	....	925,459	....	18,500	153.53	......	324.15	621.36	..	2.71	.	73.73	[illegible]
	....	.....	..	.....	.....	....	742,699	....	....	....	....	600,297	....	742,699	.....	...	288.47	......	..	190		7.08		
5	4.136 x .2514	1.040	32	.62	31.34	728,435	....	1,471,134	520,956	....	....	....	1,249,391	....	63,600	372.35	......	320.10	638.09	..	3.56	.	73.4[illegible]	[illegible]
6	4.194 x .1846	.7742	43	.62	25.53	917,714	....	917,714	....	....	297,903	....	619,811	....	23,200	405.34		405.34	249.60	.	4.51		[illegible]	[illegible]
7	4.281 x .1220	.5222	63	9.62	32.54	1,139,430	....	1,139,430	....	....	262,723	....	876,707	....	16,800	301.26	....	301.26	271.01		7.70		73.[illegible]	[illegible]
						Total.	Total.	Total.	Total.	Total.	Total.	Total.	Total.	Total.	Average.	Aver.	Aver.	Aver.	Aver.	Aver.	Total.	Total.	Aver.	[illegible]
						3,438,038	2,628,871	6,066,911	2,187,017	....	560,626	2,019,452	5,064,429	2,628,871	21,263	[illegible]5.04	245.49	277.68	401.26	186.5	21.05	26.14	73.22	72.65

Friction load at 69.15 R.P.M. 143 I.H.P. Average load 302 actual H.P. Maximum load 1431.78 actual H.P. Average constant "C" 26,300.

TABLE 4.

Giving Data of Test Conducted on 30 x 72 Inch Single, Non-Condensing Rolling-Mill Engine. Fly-Wheel Diameter—21 Feet. Fly-Wheel Rim—15 1/4 x 15 1/4 Inches. Weight of Fly-Wheel Arms—17,2[illegible] Pounds. 3[illegible] x 4.323 Inch x [illegible] Feet. Billet Rolled to .112 x 4.257 Inch x 68.8 Foot Plate.

1	3.145 x 4.00	12.58	2	7.37	19.1	44,323	....	44,323	68,385	....	....	....	112,708	....	9,500	141.31	....	141.31	358.25		[illegible]		44.11	43.85
	....	.....	..	.....	.....	....	399,222	....	....	....	....	35,991	....	399,222	.....	......	134.71	......	......	137		[illegible]		
2	1.776 x 4.25	7.548	4	4.25	40.0	57,815	....	457,037	161,560	....	....	....	219,375	....	7,800	152.88	......	137.04	558.85	.....	[illegible]		[illegible]	43.25
	....	.....	..	.....	.....	....	236,998	....	....	....	....	115,971	....	236,998	.....	..	167.67	......	.....	181.5		[illegible]		
3	.955 x 4.272	4.079	8	.62	45.9	130,442	....	367,440	269,533	....	....	....	400,275	....	11,400	193.32	......	176.74	606.48	..	1.[illegible]		[illegible]	[illegible]
	....	.....	..	.....	.....	....	329,973	....	....	40,000	....	....	....	369,973	.....	......	218.10	......	......	445		[illegible]		
4	.2724 x 4.25	1.157	28	4.75	71.6	475,386	....	805,359	680,630	....	....	....	1,156,016	....	10,700	249.10	......	240.46	537.55	.	3.91		[illegible]	[illegible]
	....	.....	..	.....	.....	....	331,007	....	....	....	....	134,366	....	331,007	.....	...	215.84	.....	...	341		[illegible]		
5	.2753 x 4.166	1.147	28	7.25	9	456,791	....	787,798	....	....	197,340	....	259,451	....	17,300	222.96	.. ..	220.67	125.74	..	3.75		40.68	40.84
6	.1611 x 4.25	.6846	48	.....	40.3	609,496	....	609,496	111,972	....	....	....	721,468	....	19,300	257.08	..	257.08	304.35	.	4.31		41.38	40.81
7	.112 x 4.257	.4768	68	9.62	30.3	655,290	....	655,290	211,947	....	....	....	867,237	....	37,600	242.26	......	242.26	325.11	....	4.85		40.[illegible]	[illegible]
						Total.	Total.	Total.	Total.	Total.	Total.	Total.	Total.	Total.	Average.	Aver.	Aver.	Aver.	Aver.	Aver.	Total.	Total.	Aver	
						2,429,543	1,297,200	3,726,743	1,504,027	40,000	197,340	286,328	3,736,530	1,337,200	20,600	233.39	166.47	212.84	357.10	222	19.30	1[illegible].07	42.47	[illegible]

Friction load at 45.6 R.P.M. — 123.19 I.H.P. Average load 309 actual H.P. Maximum load 606.48 actual H. P. Average constant "C" 20,600.

TABLE 5.

Giving Data of Test Conducted on 36 x 48 Inch Single, Non-Condensing Rolling-Mill Engine. Fly-Wheel Diameter—24 Feet. Fly-Wheel Rim—16 1/2 x 11 3/8 Inches. Weight of Fly-Wheel Arms—14,000 Pounds. 3.7 x 4.83 Inch x 2 3[illegible] Feet. Billet Rolled to .1236 x 5.375 Inch x 63.8 Foot Plate.

1	2.409 x 5.354	12.90	3	3.12	27.7	64,009	....	64,009	325,300	....	....	....	389,309	....	21,900	206.77	..	206.77	1310	....	.54		70.02	[illegible]
	....	....	..	.....	.....	....	605,992	....	....	....	....	156,144	....	605,902	.....	..	186.97	.....	....	178	...	5.99	.	
2	1.349 x 5.375	7.25	5	9.62	43.7	105,593	....	711,565	318,794	....	....	....	424,387	....	10,580	224.86	......	202.56	856	.....	.90		69.6[illegible]	68.34
	....	....	..	.....	.....	....	265,046	....	....	....	....	162,650	....	265,046	.....	..	239.30	.....	....	241	.....	2.00		
3	.807 x 5.387	4.35	9	8.12	40.0	292,340	....	557,386	....	....	....	....	741,254	....	21,100	313.14	......	273.42	793	..	1.70	.....	68.35	64.[illegible]
	....	....	..	.....	.....	....	334,460	....	....	....	....	286,264	....	334,460	.....	....	319.99	.....	....	231	...	1.90	.	
4	.327 x 5.284	1.73	24	3.62	60.2	741,425	....	774,861	957,900	....	....	....	1,699,325	....	21,900	377.00	......	357.33	860	...	3.59	..	67.02	63.[illegible]
	....	....	..	.....	.....	....	567,130	....	....	....	....	260,240	....	567,130	.....	...	387.84	.....	...	396	...	2.68	.	
5	.2133 x 5.299	1.13	37	2.62	34.6	1,385,134	....	1,952,264	260,240	....	....	....	1,645,374	....	50,350	415.41	......	406.70	495	.....	6.04	.....	65.83	63.[illegible]
	....	....	..	.....	.....	....	2,102,282	....	....	....	....	728,672	....	2,102,282	.....	..	279.74	......	...	280	..	13.65	.	
6	.1236 x 5.375	.66	63	9.62	41.5	1,972,488	....	4,075,770	409,878	....	....	....	2,382,366	....	52,200	405.49	......	331.27	457	.....	9.48		69.60	[illegible].45
						Total.	Total.	Total.	Total.			Total.	Total.	Total.	Average.	Aver.	Aver.	Aver.	Aver.	Aver.	Total	Total	Aver	Aver.
						4,560,989	3,874,910	8,135,875	2,721,026	....	....	1,593,970	7,282,015	3,874,910	42,000	384.5	230	324	604	262	22.25	26.22	68.2	63

Friction load at 65 R.P.M. — 157.3 I.H.P. Average load 420 actual H.P. Maximum load 1,310 actual H.P. Average constant "C" 42,000.

TABLE 2.

Giving Data of Test Conducted on 36 x 48 Inch Single, Non-Condensing Rolling-Mill Engine. Fly-Wheel Diameter—24 Feet. Fly-Wheel Rim—16 1/2 x 11 3/4 Inches. Weight of Fly-Wheel Arms—14,000 Pounds—2.13 [illegible] Inch. Billet Rolled to .1047 x 13.621 Inch x 54.354 Foot Plate.

DATA CALCULATED FROM INDICATOR AND SPEED DIAGRAMS AND FLY WHEEL DATA.

Pass No.	Piece. Section Inches 1	Piece. Area Sq. In. 2	Length Ft. 3	Length Ins. 4	Approx. Reduction. Per Cent. 5	Work Done By Cylinder During Pass Foot Pounds 6	By Cylinder Between Passes. Foot Pounds 7	Total. Foot Pounds 8	By Fly Wheel During Pass. Foot Pounds 9	By Fly Wheel Between Passes. Foot Pounds 10	On Fly-Wheel. During Pass. Foot Pounds 11	On Fly-Wheel. Between Passes. Foot Pounds 12	Actual Total. Including Friction Load. On Billet During Pass. Foot Pounds. 13	Actual Total. Between Passes. Foot Pounds. 14	Constant "C." Work Done on Each Square Inch of Reduction of Section Per Ft. Length of Piece Foot Pounds. 15	Average I.H.P. During Pass. 16	Average I.H.P. Between Passes. 17	Average I.H.P. Total. 18	Actual H.P. During Pass 19	Actual H.P. Between Passes 20	[illegible] 21	[illegible] 22	[illegible] 23	[illegible] 24
1	1.905 x 13.416	25.558	3		29.62	98,484		98,484	309,958				408,442		11,900	328.56		328.56	1360.11		.54		73.[illegible]	[illegible]
							648,836					309,958		648,000			299.86			300		3.93		
2	1.171 x 13.520	15.832	4	10.62	38.05	129,048		777,884	377,365				560,413		9,100	328.23		304.24	1281.49		.71		73.[illegible]	69.95
							349,502			54,732		404,234		404,234			401.74			464		1.58		
3	.829 x 13.500	11.191	6	11.12	29.31	181,867		530,369	225,743				407,610		10,000	400.89		401.45	873.63		.82		69.25	[illegible]
							981,948					162,469		981,946			468.26			746		2.39		
4	.534 x 13.462	7.172	10	9.62	35.02	438,590		1,420,538	453,990				892,580		16,700	488.31		476.42	990.16		1.63		68.[illegible]	[illegible]
							505,627					263,868		505,627			525.78			526		1.74		
5	.377 x 13.453	5.078	15	3.00	29.19	782,522		1,288,149	223,538				1,006,060		23,600	572.40		553.13	721.75		2.48		67.[illegible]	65.15
							946,607					456,871		946,607			511.74			612		2.81		
6	.203 x 13.607	2.769	27	11.50	45.47	1,421,606		2,368,213	774,895				2,196,501		26,800	507.08		547.07	878.69		4.54		[illegible]	[illegible]
							1,393,547					698,270		1,393,547			521.07			520		4.84		
7	.160 x 13.576	2.168	35	8.50	21.70	1,421,936		2,815,483	50,917				1,481,853		40,700	438.68		476.31	458.99		5.87		[illegible]	68.05
							1,394,326					278,847		1,394,326			322.74			328		7.73		
8	.119 x 13.624	1.617	47	11.50	25.41	2,006,119		3,400,445	678,681				2,684,800		73,000	499.47		408.88	664.14		7.35		70.[illegible]	[illegible]
							1,343,825					640,875		1,343,825			482.67			480		5.09		
9	.105 x 13.621	1.426	54	4.25	11.81	2,365,299		3,709,115	1,216,787				3,582,080		257,000?	475.36		478.11	743.48		8.76		[illegible]	[illegible]
						Total. 8,845,471	Total. 7,564,218	Total. 16,408,680	Total. 4,320,874	Total. 54,732		Total. 3,224,392	Total. 13,166,345	Total. 7,618,950	Average. 41,800	Aver. 426.09	Aver. 479.05	Aver. 457.10	Aver. 782.14	Aver. 457	Total. 32.737	Total. 30.123	Aver. [illegible]	Aver. 64.91

Friction load at 74 R.P.M. — 188.87 I.H.P. Average load 628 actual H.P. Maximum load 1,360 actual H.P. Average constant "C" 41,800

TABLE 3.

Giving Data of Test Conducted on 36 x 48 Inch Single, Non Condensing Rolling Mill Engine. Fly-Wheel Diameter—20 Feet. Fly-Wheel Rim—18 1/16 x 12 7/16 Inches. Weight of Fly-Wheel Arms—14,700 Pounds—2.349 x 21.[illegible] 28.5 Inch. Billet Rolled to .259 x 22.156 Inch x 21.302 Foot. Plate.

Pass No.	Piece. Section Inches 1	Piece. Area Sq. In. 2	Length Ft. 3	Length Ins. 4	Approx. Reduction. Per Cent. 5	Work Done By Cylinder During Pass Foot Pounds 6	By Cylinder Between Passes. Foot Pounds 7	Total. Foot Pounds 8	By Fly Wheel During Pass. Foot Pounds 9	By Fly Wheel Between Passes. Foot Pounds 10	On Fly-Wheel. During Pass. Foot Pounds 11	On Fly-Wheel. Between Passes. Foot Pounds 12	Actual Total. Including Friction Load. On Billet During Pass. Foot Pounds. 13	Actual Total. Between Passes. Foot Pounds. 14	Constant "C." Foot Pounds. 15	Average I.H.P. During Pass. 16	Average I.H.P. Between Passes. 17	Average I.H.P. Total. 18	Actual H.P. During Pass 19	Actual H.P. Between Passes 20	[illegible] 21	[illegible] 22	[illegible] 23	[illegible] 24
1	1.927 x 22.083	42.554	2	10.50	17.41	31,722		31,722	253,000				284,722		9,050	125.61		125.61	1128.32		.46		70.50	67.98
							331,018			252,000				583,018			110.95			96.04		5.4		
2	1.424 x 22.270	31.722	3	10.37	25.45	47,684		378,702	520,000				573,684		12,000	114.90		111.42	1407.60		.74		65.40	[illegible]
							460,420					433,000		460,420			460.88			507		1.06		
3	1.404 x 22.083	31.000	3	11.37	2.27	242,008		702,428			571,500		329,492		*	605.35		503.04			.73		64.68	70.08
							395,407					5,988		395,407			209.88			208		3.44		
4	1.096 x 22.073	24.198	5	.75	22.26	59,087		454,494	5,988				65,075		*	135.39		194.92	137.78		.86		69.12	[illegible]
							149,048			162,424				311,472			121.40			277		2.23		
5	.908 x 22.073	20.044	5	11.75	17.12	112,239		261,287	553,890				666,129		22,600	201.42		145.46	1191.83		1.02		66.48	60.84
							1,159,607					1,060,000		1,159,607			139.50			618		3.40		
6	.683 x 22.024	15.038	7	11.50	24.07	134,696		1,294,303	900,000				1,034,696		22,900	195.21		517.12	1498.88		1.25		71.70	[illegible]
							403,123			314,000				717,123			284.92			500		2.00		
7	.571 x 22.062	12.446	9	9.62	17.23	713,541		1,116,664	170,000				883,841		20,350	724.02		506.05	928.57		1.73		63.12	61.44
							837,551					820,000		837,551			365.55			364		4.18		
8	.329 x 22.324	7.347	16	7.87	40.96	605,094		1,442,645	861,519				2,466,613		25,750	388.12		374.44	1558.23		2.88		70.14	[illegible]
							1,645,332					196,000		1,645,332			606.91			686		4.37		
9	.259 x 22.156	5.749	21	3.62	21.74	678,824		2,324,156	1,253,000				1,931,824		45,300	308.57		460.04	870.59		4.03		72.72	60.60
						Total. 2,624,895	Total. 5,379,506	Total. 8,006,401	Total. 5,523,397	Total. 728,424	Total. 571,500	Total. 3,514,988	Total. 8,235,776	Total. 6,107,930	Average. 29,450	Aver. 347.79	Aver. 346.44	Aver. 347.10	Aver. 1189.45	Aver. 409	Total. 13.69	Total. 27.30	Aver 68.21	Aver. 63.70

Friction load at 67 R. P. M. - 177 I.H.P. Average load at 602 actual H.P. Maximum load at 1,558 actual H.P. Average constant "C" 30,400

* Probable slight error due to insufficient sensitiveness of chronograph and measurement of time.

indicator, both width and height for the first pass in A become known. But the steel is not edged for every pass in A; it therefore happens that the widening effects in successive passes in A due to rolling are not taken into consideration, or at best can only be estimated. A similar uncertainty will of course occur if the ingot assumes the position indicated in B. It is this uncertainty of the width of the steel after each pass which may introduce large errors; for if the errors be ¼ inch only, and if the steel in the blooming-mill rolls is 16 inches high, as a result of the error there would be a difference of four square inches. But a difference of ½ inch between the actual width and the assumed one may not be uncommon. For the above reasons, in all mills where measurements of width and height of steel cannot be made with micrometer calipers it would be well to devise some method for the rapid and accurate determination of the length of the steel after every pass. Knowing the original weight of the ingot and the accurate length for each pass, the exact cross-sectional area is easily obtained.

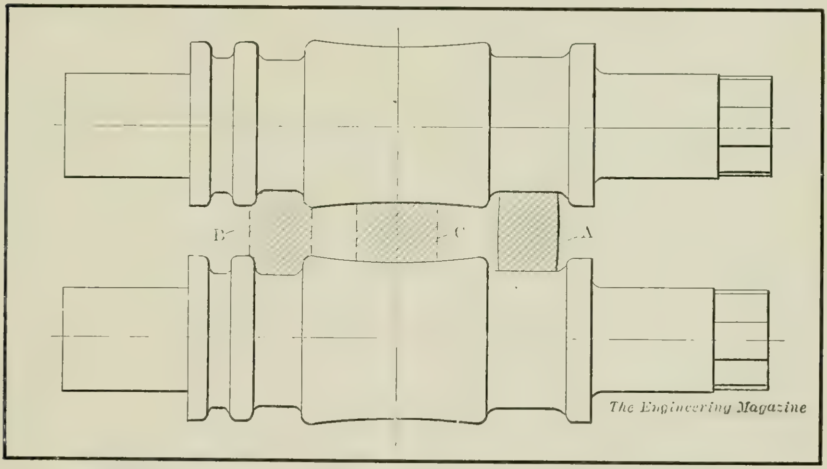


FIGURE 13. SHOWING RELATION BETWEEN ROLL PASSES AND AREA OF INGOT.

When the area is accurately determined once for each pass, the length and the approximate reduction can be determined with equal exactness for each pass in the manner described previously, and thus the denominator of Constant C is found accurately.

The method of finding the work done by the steam in the engine cylinder has been given already and no further comment seems necessary. If first-class instruments are at hand wherewith to take measurements, and if these measurements make clear beyond all doubts all the indicator diagrams belonging to every pass and to every interval and further, if these measurements show the exact time or duration of every pass and every interval, then the working up of the data will present no difficulty and the results obtained can not help but be accurate. The same is likewise true of the energy given out by the flywheel.

The data in columns 9 in the Tables of the tests show what a very important part the flywheel plays in rolling-mill work. A careful study of these figures soon makes clear that in the comparatively short passes the percentage of flywheel work to the total work is greatest. In Table 3, for instance, the flywheel work done during the first pass is 253,000 foot-pounds, while the steam in the cylinder of the engine did only 31,722 foot-pounds of work. This represents 89 per cent and 11 per cent respectively or these two sources of energy. It should be borne in mind, relatively speaking, that flywheels are of great importance in short passes only; in long passes, or in passes where the engine has not time to come back to its normal speed by reason of forced production, they will create a positive loss in power.

Nothing need be said of the average indicated horse power columns nor of the actual horse power columns as the same data are given in the preceding columns expressed in foot pounds. The actual horse power is the total power required for rolling as computed from the cylinder and the flywheel work.

The rate of revolutions per minute column is interesting. When considered in connection with the time column it shows clearly how quickly the speed of the engine changes during rolling.

Constant C.

In studying Constants C for the different tests it will be noticed that in some cases certain constants are much greater than either the following one or the preceding one. At first I could find no explanation for this, for I reasoned that since the cooling of the steel took place at a practically constant rate, the power required for rolling the steel, or Constant C, should increase likewise at a practically constant rate, because the temperature of the steel rolled was thought to be the only controlling factor in the power requirement in rolling mills. It was my opinion that in the ordinary rolling of a billet or an ingot, as the steel cooled, there would be constantly more power required for Constant C for the successive passes, and therefore Constant C would be found gradually becoming greater. This tendency of actual increase of Constant C with the cooling of the ingot or billet is evident from the examinations of Constant C in the different tests; but there is not as much steady regularity in the increase of Constant C as one would expect. It was therefore soon evident that there must be some other influence at work which tends to make Constant C higher than the temperature alone could bring about.

When we scrutinize Constants C for the different passes it will be found that those which seem out of place are in nearly all cases for closed passes, i.e., for passes where the steel is surrounded on all sides by the rolls. In the finishing passes where the rolls press only on two surfaces of the steel and where the temperature of the steel has not dropped below a normal of say 1,700 degrees F., Constant C does not appear out of place when compared with the preceding one. In closed passes where the steel is surrounded on all sides by the rolls, the lateral displacement of the steel is preventd by the walls of the pass; in this manner much energy no doubt is lost through friction, the magnitude of which depends on the relative width of roll pass, width of steel entering the pass, and power exerted at the rolls.

In the rolling of structural shapes or rails, for instance, it will no doubt frequently happen that large Constants C are encountered. This will be due to the fact that the shape of the finished product makes necessary deep cuts into the steel at certain stages of the rolling, forcing the metal with great pressure against some surface or surfaces of the roll-pass not parallel to the axes of the rolls.

To what extent all unnecessary friction in the roll-pass may be eliminated and thereby the power requirement for the pass in question be brought down to the smallest figure is a question for the skilful roll-designer to determine. It will no doubt always be the case that Constant C is smaller for flats, squares, and round sections than for structural shapes, rails, etc. From a careful examination of some eighty tests conducted with the greatest possible care, I have come to the conclusion that by paying proper attention to details mentioned in a preceding paragraph the power required for rolling steel may in many cases be reduced 50 per cent and perhaps even more.

If we now take the Constants C and the temperatures during the rolling of the different passes, and plot one as ordinates and the other as abscissæ, we obtain a very interesting curve. Between the proper limits its shape and general direction is similar to the tenacity-temperature curve shown in Figure 12.*

---

* THE ENGINEERING MAGAZINE, October, 1910, page 54.

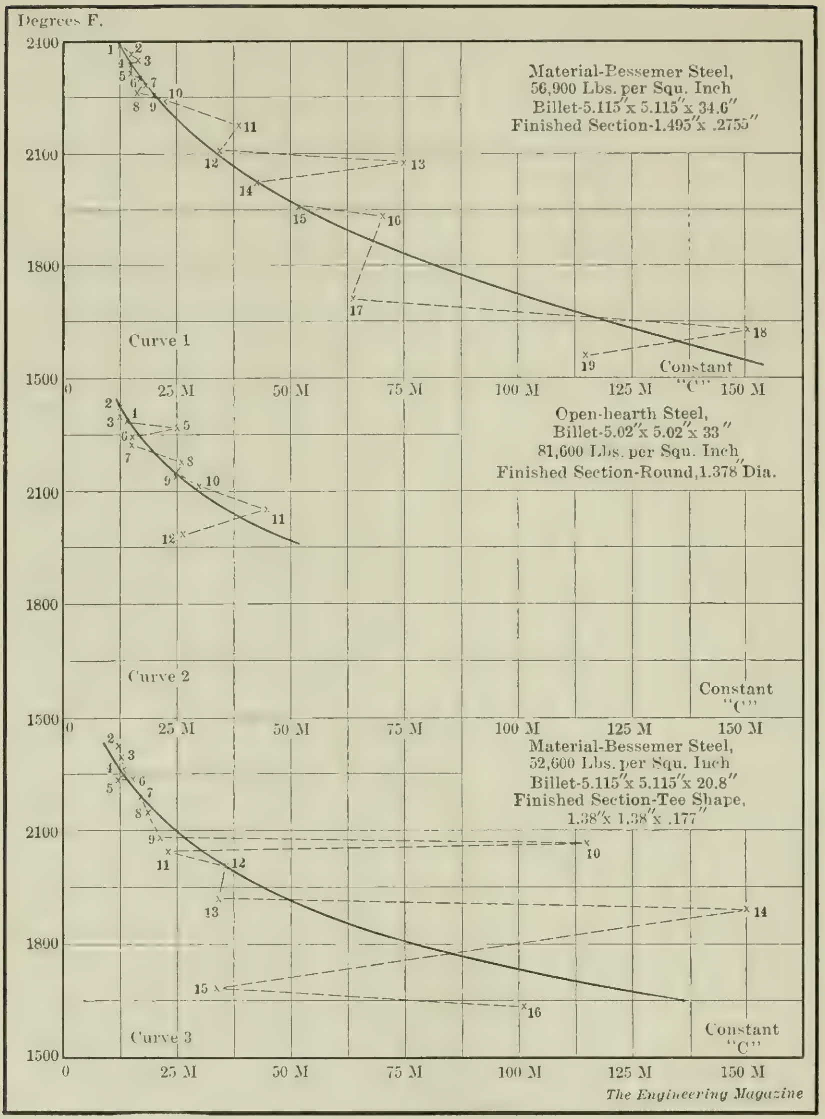
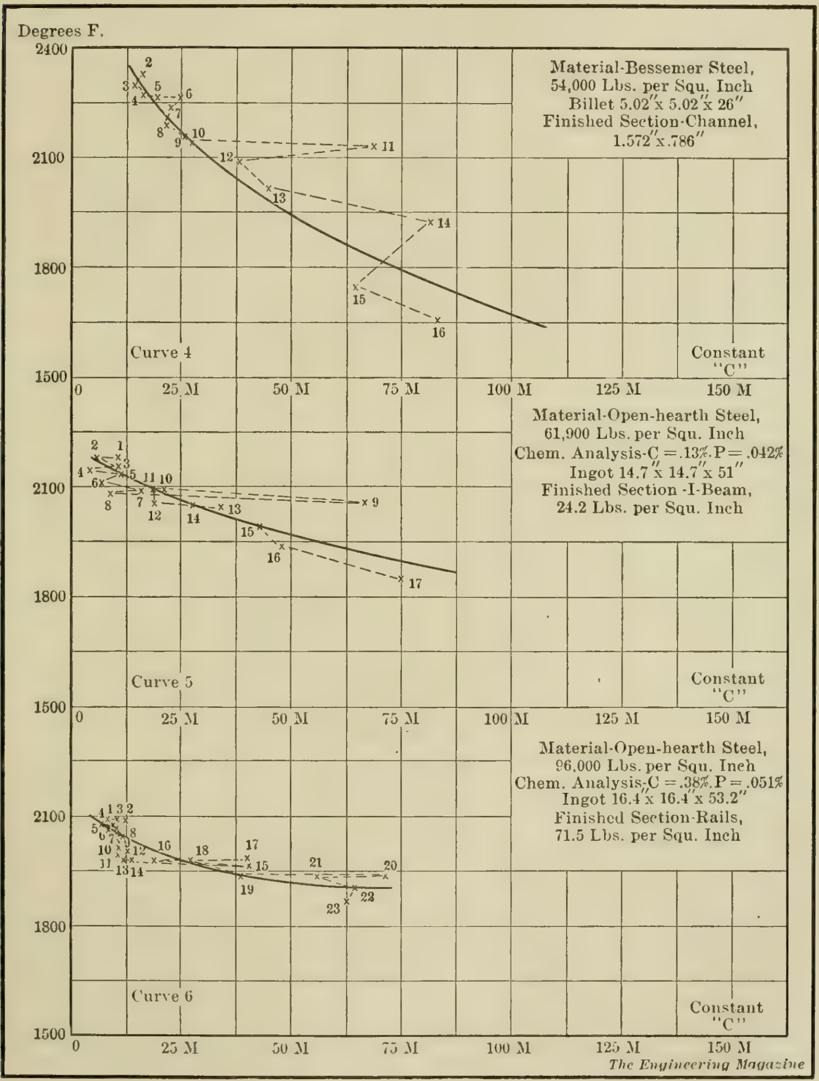


FIGURE 14. CONSTANTS C IN VARIOUS ROLLING-MILL TESTS.

As already stated, the temperatures were not taken during my tests, but in order to show the value and importance of curves previously mentioned for the rolling mill man and the roll-designer, I worked out the Constants C of some of Mr. J. Puppe's rolling-mill tests. These curves are shown in Figures 14, 15 and 16. They show at a glance the power required for any pass at a certain temperature. That none of these curves can be taken in the accurate determination of the power required for rolling steel will soon appear by a careful study of these different curves which are for flats, rounds, squares, structural shapes, rails and steel ties. The irregularity of sucessive Constants C is evident in these curves in the same manner as in the case of my own tests.



The Engineering Magazine

FIGURE 15. CONSTANTS C IN VARIOUS ROLLING-MILL TESTS.

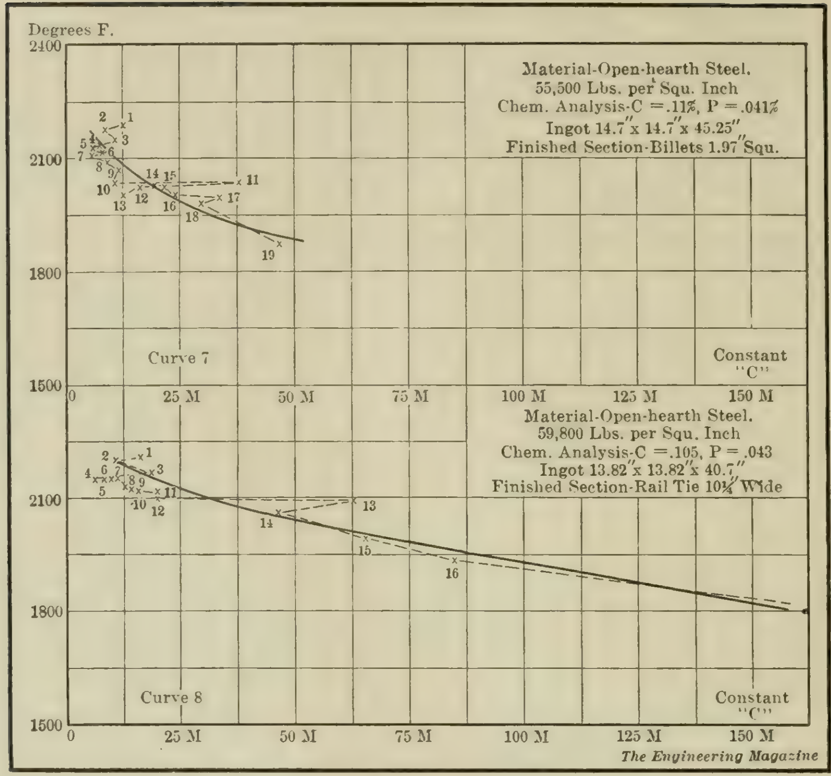
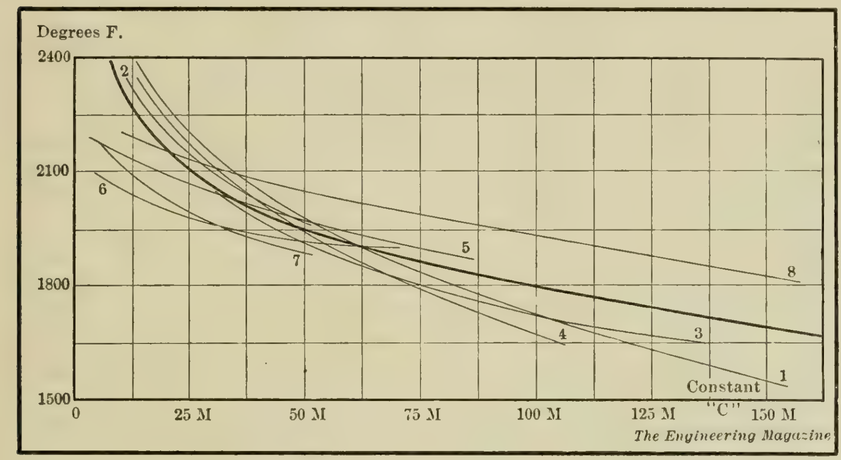


FIGURE 16. CONSTANTS C IN VARIOUS ROLLING-MILL TESTS.

The broken irregular curves are those obtained by connecting the Constants C as figured from the carefully conducted tests. This irregular curve I have chosen to call the "Roll-Characteristic," because with the same roll-passes, the same reductions, and the same temperatures, the same points must always be obtained in rolling a steel similar in character to the one rolled when the data for these points were procured originally. But this wavy, irregular curve seems ill suited to determine the power required for a rolling mill about to be designed. Among other things the purpose of the designer should be to do the necessary work of rolling in the different passes with the least expenditure of energy. If the work for the different passes be done most economically, the roll-characteristic will lose its irregularity and become a smooth curve the general direction of which is indicatd by the roll-characteristic. These smooth curves which are drawn into the points that form the roll-characteristic we will call the Constant C curve for the section in question. If now the size of an engine or motor for rolling mill work is to be determined, it will be advisable to choose that Constant C curve which shows the smallest ordinates for the given abscissæ. For accurate results the proper Constant C Curve must of course always be chosen, i. e., a Constant C curve for plate-rolling would give only approximate results if used in computations for the proper size of a rail-mill engine or motor.



The Engineering Magazine

FIGURE 17. COMPARISON OF CURVES IN FIGURES 14, 15 AND 16.

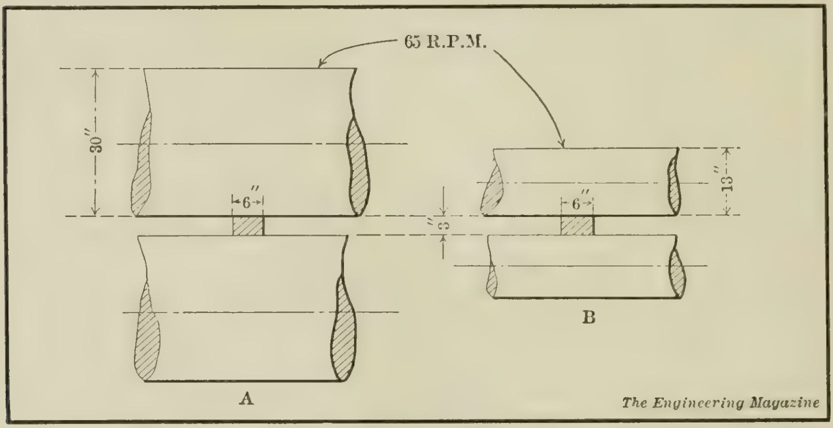
In Figure 17 all the Constant C curves given in Figures 14, 15, and 16 are shown. A general averaging curve, A, has been drawn into these Constant C curves, which general averaging curve will be of advantage in the determination of the power requirement where many different shapes are rolled in one mill.

INFLUENCE OF MATERIAL AND SIZE OF ROLLS ON POWER REQUIREMENT.

The opinion is frequently entertained, and I confess that at one time I also held this opinion, that it takes much more power to roll the hard steels than is required for the rolling of the softer steels. Experiments made by careful investigators have proved, however, that this is not the case. The apparently larger power requirement of the hard steels, especially the high-carbon steels, is due to the fact that they cannot be worked at temperatures as high as those at which the so-called soft steels can be worked. The experimental data above referred to indicate that if the temperatures were alike for both soft and hard steels, Constant C for these two kinds of steel should also be alike.

It is frequently stated without qualifications that rolls of small diameter require less power per certain reduction than those of large diameters. This might be interpreted to mean that for a certain reduction of a given material at a fixed temperature the Constant C for a rolling mill with small roll diameter would be less than the Constant C for a rolling mill with large roll diameter.

It is perfectly evident why a rolling mill with rolls of small diameter will require less power than a similar mill having rolls of larger diameter, provided reduction, temperature, quality of steel, and revolution per certain time are the same in both cases. Under such conditions the mill with the smaller roll diameter is doing actually less work and therefore it should not require the same power as the mill with the larger rolls. As an example let us assume the following case:



The Engineering Magazine

FIGURE 18. RELATIONS OF ROLL DIAMETER TO SPEED OF ROLLING AND POWER REQUIRED.

We have a pair of 30-inch rolls and a pair of 13-inch rolls, each pair revolving at 65 revolutions per minue, set exactly the same distance apart; and into each of these rolls is entered say a 3-inch by 6-inch billet, both billets cut from the same ingot and both heated to the same temperature; see Figure 18. Now, since the temperatures of the billets between both sets of rolls are alike, and further, since the rolls are set the same distance apart, and since the billets have the same dimensions, the reductions in both cases must be the same. From this fact that the reductions are the same it follows that the force or pressure exerted upon the billets must be alike in both cases. Let us assume for our numerical example that the rolls press upon the steel with a force of 100,000 pounds at the time of rolling.

The roll speed of the 30-inch rolls will be 8½ feet per second and that of the 13-inch rolls at the same number of revolutions per minute, 3.7 feet per second. In rolling, therefore, during one revolution the 30-inch rolls will convey the piece between them 8½ feet per second approximately, if we disregard slip and the forward stretching effect, and the 13-inch rolls will convey it 3.7 feet per second. In order to bring about the same reductions in cases A and B in Figure 18, the pressure in the case of both sets of rolls must be the same as stated already. This pressure was taken at 100,000 pounds during the rolling of the steel. The total work done on the billets will therefore be in the 30-inch rolls 100,000 × 8.5 or 850,000 foot pounds or 1,544 horse power and for the 13-inch rolls 100,000 × 3.7 or 673 horse power. If we now increased the revolutions per minute of the small rolls to 150, the surface speed will be the same as that of the 30-inch rolls at 65 revolutions per minute; the speed at which the billet leaves the 13-inch rolls driven at 150 revolutions per minute, will be the same as the speed coming from the 30-inch rolls driven at 65 revolutions per minute, and therefore since force, distance, and time are equal in both cases, the power required will likewise be the same in both cases. The real reason therefore why under similar conditions small rolls require less power in rolling than large rolls, is that the small rolls take more time than the large rolls for the performance of the same work if the revolutions per minute are the same in both cases.

The above discussion has been somewhat theoretical. In actual practice when the rolling of a billet or bloom during the entire mill-cycle is considered, if the necks of the two sets of rolls are the same, the small rolls at 150 revolutions per minute would actually require more power instead of less. This is so because in order to roll over a certain length the smaller set of rolls has to make 2.3 as many revolutions as are made by the larger set of rolls, and therefore the friction load is greater, not of course in proportion to the surface speed of the rolls, but still it is greater, and to this extent the friction load and therefore the total power required for rolling the steel in the small diameter rolls is greater instead of less.

We have also spoken of the great influence which the roll-pass friction has on the power requirement in rolling steel. The smaller the rolls the less will be the lateral widening effect of the steel, and therefore the smaller the roll-pass friction and consequently the smaller the power requirement. That the widening effect will be less with small rolls than with large ones is seen by the simple performance of stretching a piece of heated steel with hammers that have the cross-peens all of one length but of different widths. A simple experiment of this kind will quickly show that the ratio of stretching to widening out is much greater with the narrow cross-peens than with the wider ones.

In order to design rolls intelligently we should have accurate data of the magnitude of the effect produced by lateral roll-pass friction, and this would make a very useful field of investigation for the experimental departments of our large steel companies. To know merely "of an effect" is of practically no value in work of this kind; it is the "how much" that counts. An experimental roll-train with a corps of efficient investigators carrying on experiments along broad lines would soon put roll-design on a scientific basis and take away from the roll-shop that much prevailing and foolish secrecy and mysticism.

Cost of Power in Rolling Mills.

In many iron and steel works it is necessary to determine for the accounting departments the power consumed by the different rolling mills in rolling the various shapes. In some cases accounting departments make estimates using engine or boiler capacities as a basis, while in others the number of operating hours is used as a basis for power distribution. Both methods are of course unsatisfactory and fundamentally wrong. The distribution of power should be based on the power actually consumed and on the tonnage produced in the mills. The power actually consumed in rolling mills depends upon the reductions, and not upon the engine or boiler capacities or the operating hours. If reductions are not considered the results obtained may in many cases be obviously far from the true results. Even if weight of steel and reductions are considered, the results will not be strictly exact because the temperature of rolling usually cannot be considered. However, even if temperatures are not taken into consideration, the average results for the given shapes will be sufficiently accurate if weight of steel and reductions are taken into account, since with a great number of billets or ingots under consideration the average temperatures of the steel in rolling will fairly well agree.

A very convenient way therefore to fix the power required for rolling the different products is to plot a chart similar to the one shown in Figure 19, in which the work for a ton of steel enters as a factor in the abscissæ and in which the horse-power hours are plotted as ordinates. The ordinates for this chart, which has been worked up from the data contained in Table 2 are determined as follows:

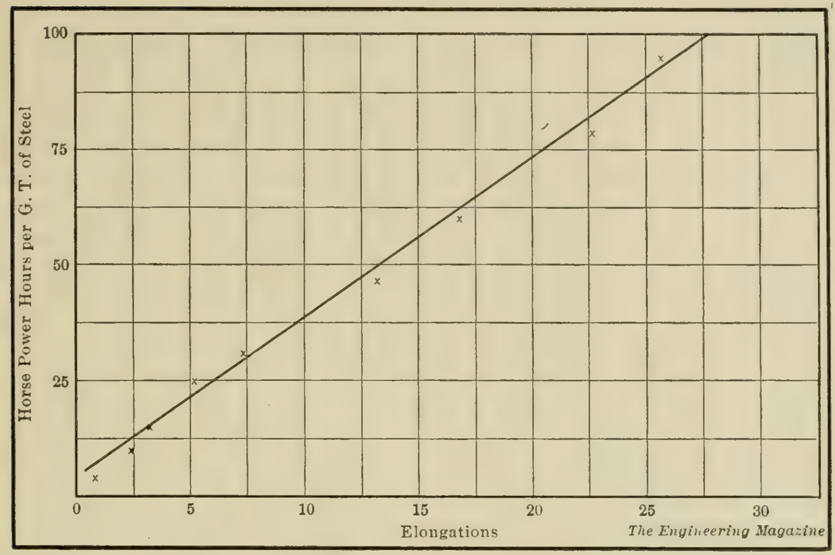


FIGURE 19. CHART OF POWER REQUIRED PER TON OF STEEL.

Assume an hourly production of 6.25 gross tons of finished plate. The trimmings on the shear table which are counted as scrap pass likewise through the rolls and they too must be counted. Assume this scrap to be 10 per cent of the tonnage made, so that the total hourly production is 6.87 gross tons. Before reaching the shear table each finished plate weighs 255 pounds; there must be rolled therefore per hour (2,240 ÷ 255) by 6.87, or about sixty billets. The average time of rolling each billet is one minute three seconds, and at this rate the total time of rolling the above tonnage would be 63 by 60 or 3,780 seconds or 1.05 hours. When the eighth pass of billet A enters the rolls, billet B enters the first pass; in this manner two billets are in the rolls for 22 per cent of the time during normal operation and for this reason the regular tonnage of 6.87 gross ton is usually made in 56 minutes actual rolling time. On an average, therefore, 4 minutes are used up every hour for unavoidable delays with tables, transfers, shears, etc. Since these delays do not come together but are scattered over the whole hour, the engine is not shut down but continues to operate during these delays. Therefore the total power chargeable to the rolling of one ton of steel must also include the power expended during unavoidable delays, and these unavoidable delays must find expression in the curve. A good way and one perfectly correct will be to charge this power expended during delays equally to all passes.

The friction load of the engine and mill is 188.87 horse power, which for four minutes would be 25,000,000 foot-pounds. Since there are sixty billets rolled per hour, and further since every billet receives nine passes, each pass would have to receive a delay charge of 25,000,000 ÷ (60 by 9) or 46,300 foot-pounds. The work chargeable to every pass will be the actual total work required for rolling that pass, inclusive of friction load from the beginning of one pass to the beginning of the next, plus the power chargeable to delays. This sum multiplied by the number of billets in one ton will give for the mill and the product in question the horse-power hours required for the rolling of one ton of steel in that particular pass; in the present case the horse-power hours are shown in the ordinates of the curve in Figure 19.

The above information, however, is expressed in terms too narrow for general application in the correct determination of the power charges in rolling-mill work. The actual effect produced should also enter as a factor into the above figures. This can be done by stating the reduction brought about in the pass in question in terms of the cross-sectional area of the finished rolling-mill product, or what is the same and perhaps a little more convenient, by stating the length of the steel after a pass in terms of its original billet or ingot length.

A set of curves for the different products rolled in the different mills giving the horse-power hours for the different elongations should be in possession of every steel-works accounting office which finds it necessary to show the power costs on the cost-sheets. Table 6 on page 233 shows some of the steps necessary in order to arrive at the values of horse-power hours for the different elongations of the steel.

ACCURACIES OBTAINED ON STEAM-DRIVEN MILLS AND ELECTRICALLY DRIVEN MILLS COMPARED.

It is often stated that in the case of electrically driven mills the power requirement for the different passes can be determined with greater ease and accuracy than in the case of steam-driven mills. This may perhaps be true in a measure; the electrical instruments are more convenient and perhaps are more accurate than the instruments usually employed in steam-engine tests. However, I desire to make the statement here that for practical purposes the horse-power computations carried to the second and third decimals, easily possible with electrically instruments, are of no greater interest than when they are carried to one decimal point only, which of course can be done with the indicator without any trouble, provided all data including the speed of the engine are known for the time when the diagram was taken.

TABLE 6.

Showing Horse-Power Hour Requirement Per Gross Ton of Plate (Table 2) for Different Elongations in a Mill With a Normal Production of 165 Gross Tons Per 24 Hours.

		Work Done on One Billet.		Work Done Per G. T. of Billets.	
No. of Pass.	Elongations in Original Billet Lengths.	From One Pass to Next One Inc. Delay Charge Ft. Lbs.	Up to Present Pass Inc. Friction Load & Delay Charge in Ft. Lbs.	Ft. Lbs.	H.-P. Hours.
1	2	3	4	5	6
1	1.41	1,102,740	1,102,740	9,645,000	4.86
2	2.30	956,947	2,059,687	18,000,000	9.09
3	3.26	1,435,858	3,495,545	30,600,000	15.42
4	5.10	1,444,507	4,940,052	49,450,000	24.90
5	7.20	1,998,967	6,939,019	60,600,000	30.61
6	13.20	3,636,248	10,575,267	92,500,000	46.65
7	16.80	2,922,479	13,597,746	118,800,000	60.00
8	22.60	4,074,925	17,672,671	154,500,000	78.00
9	25.60	3,628,386	21,301,057	186,300,000	94.00

A further proof that it serves no purpose to carry the decimals beyond one point in the power computations of a rolling mill, I believe, is found in the fact that sometimes during rolling the pressure between the rolls is so great that the temperature of the steel is increased. I know of a test conducted with the greatest precision where by actual measurements an increase of 56 degrees F. was noted at the end of the third pass. This test was made on a three-high mill driven by a motor; in this mill a billet of 825 pounds was rolled into mine rails weighing 17.9 pounds per yard. The duration of this third pass was 1.11 seconds and the temperature of the steel just before the third pass as measured with a Holburn-Kurlbaum Optical Pyrometer was 2,095 degrees F. If according to Wedding we take the specific heat of a low-carbon steel at this temperature at .3, a rise of 56 degrees F. would in this case correspond to a power equivalent of

$$\frac{.3 \times 815 \times 56 \times 778}{550 \times 1.11} \text{ or } 17,500 \text{ horse power.}$$

Of course it is needless to say, the temperature of the total weight of steel was not raised 56 degrees F. but only a thin envelope of it. I know of no way by which to determine the actual weight of steel the temperature of which has been raised during rolling. If, however, we assume that the temperature of a thin envelope of the steel spread over the entire billet and weighing just one pound was raised 56 degrees F. during the pass, we would still have a power equivalent of

$$\frac{.3 \times 1 \times 56 \times 778}{550 \times 1.11} \text{ or } 21.4 \text{ horse power.}$$

From this it is readily seen that for the work in question any electrical instruments enabling us to compute the power requirement closer than the steam-engine indicator will permit are of no superiority as far as practical accuracy goes, because it serves no purpose to eliminate a small possible discrepancy when errors more than ten times as great may occur which cannot be determined.

Increases in temperature during rolling are not as infrequent as many may suspect. In a list of over fifty tests which I examined carefully I found thirty-nine cases in which the temperature was higher anywhere from 2 degrees F. to 56 degrees F. in subsequent passes than in preceding ones.

Conclusion.

The employment of electric motors for rolling-mill drives makes it possible at any time to know how the rolling is conducted. The ammeter tells instantly the current used during any pass and the integrating watt-meter tells accurately the power used per ton of finished material. All this is most excellent information and it is the kind of information needed by the electrician, roller foreman, superintendent, or manager of the works. But the designer needs all this information and a great deal more besides. For him the chart of a recording ammeter or watt-meter is not sufficient; he must know in addition and with equal accuracy temperature at rolling, reduction, time of different events, speeds, etc., and of course concerning these electrical instruments cannot give any information.

The great difficulty experienced in arriving at the proper size of engine or motor for a rolling mill is due to the fact that not all the necessary information is at hand when the dimensions are worked out, and consequently all computations and estimates are based on what some other mill is doing. It must indeed be considered remarkable if under such conditions the new mill fulfils all previous requirements. There are perhaps no two cases alike, even if the same tonnage is to be produced by each mill. If it were stated for example that it takes say 95 kilowatt-hours per ton to roll plates of 51-inch by .22-inch sectional dimensions from a billet weighing 450 pounds, it does not at all follow that in some other mill it will likewise take 95 kilowatt-hours per ton produced. In another mill the temperature of rolling, the speed of the mill, and the number of passes may be different; the reductions may be distributed differently—in fact, the entire roll-pass design may be different. All these items have an important influence on the power required in rolling.

As power for a rolling mill one of the following may be chosen: steam engines, gas engines, direct-current motors, and alternating-current motors. The characteristics of these types of machines are not alike, however, and as a matter of course these characteristics must be considered so that it may be determined in advance what effect the different load conditions will have on the engine or motor.

The steady and economical operation of the mill depends in part on the absence of roll breakage. To avoid the breaking of otherwise good rolls it should be known in advance just what the allowable reduction is for a set of rolls and what stresses are set up by the different reductions. With regard to these matters only reliable and detailed tests of course can furnish information.

In the design of a new mill it is highly desirable that the engine, or whatever other motive power is used, work at a load as constant as is possible in rolling-mill work. In order to accomplish this constant operation it becomes necessary to design the different passes as nearly alike as is obtainable from the standpoint of power requirement. The equalizing of the power required for the different passes is accomplished by a proper proportioning of the roll-speed and by a proper proportioning of the reduction. In a two-high mill this proper proportion is accomplished by taking the first passes slowly with a considerable draft. The finishing passes are taken with much less draft and with much greater speed. In this way the power required for the different passes is equalized. The same thing is accomplished in three-high mills by running the finishing rolls at a greater rate of speed than the roughing rolls.

In this discussion we cannot of course attempt to point out all the different uses of the data contained herein. But the intelligent, rolling-mill designer and rolling-mill man will have no difficulty in making proper use of these data as problems arise in their work which make exact information necessary.

THE ORGANIZATION OF GREAT CORPORATIONS.

By Wm. W. Mulford.

IF you are a corporation wage earner, and seven out of every ten of the wage earners of the United States are, then you surely have a fellow feeling for the office boy who, as the story goes, when asked "Who is the responsible party here?" replied "I don't know who's responsible, but I'm always to blame."

Was the boy at fault, or was the root of the trouble deeper, possibly in the organization itself?

The "Trusts" are with us because they fill a specific requirement. They are well worth while and when their virtues outweigh their faults are greatly to be desired. How firmly they are entrenched may be judged from the statistics which Mr. Winchell, president of the St. Louis and San Francisco Railroad, has given us:

> There are more than one million corporations doing business in these United States; of all the capital employed, 82 per cent is in the carrying on of the business of incorporated concerns; corporations employ 71 per cent of all wage earners, pay 72 per cent of all the wages, and buy 75 per cent of all the materials used in manufacturing enterprises of the country.

For the industrial world these figures challenge attention.

It was my honor to know Dr. Orton, a "Louis Agassiz man," one time president of the Ohio State University. In discussing the economic conditions of the day, about the time the first steel corporation combinations were being formed, I asked, "Dr. Orton, what do these combinations of big corporations lead to?" To which he replied, "I am very optimistic on the outlook. They lead to socialism." "But, Dr. Orton, you are not a socialist, and I am not a socialist!" And as I recall it, this was his reply:

> Well, I am an old man, I can prophesy. You are a young man. It will not do for a young man to prophesy. We are neither of us socialists in the sense of the fanatic so-called German student, nor in the sense of the labor-union demagogue, but there is a right form of socialism. You have seen the oil business gradually absorbed under the control of one great corporation, or call it "trust" if you like. You have seen the same thing in the sugar business. And now the iron men are attempting to

work out their industrial problems. You will see a great corporation formed, call it "Steel Trust" if you like. This will be dominated by one strong man, possibly an unpopular man, possibly a selfish man, possibly a narrow man, certainly a far-seeing man of strong will and determination. But he will die. Another man with perhaps a little broader humanity and not so strong will power, will take his place. But he, too, will die. The time will come when the great rank and file of men engaged in this industry, the men with money, the men of brains, and the men of sinew, will realize that they are themselves the foundation strength of the steel business. The industry will have developed from the "one-man" policy to the broader and stronger policy determined by the will of the majority of the true masters of this particular industry.

I believe that you will live to see the time in this country when not only the Declaration of Independence, and the Constitution of the United States, but also the Recognition of Industrial Organizations are the prominent forces in the land.

The outlook following the financial storm is brighter than it has been for many a long day. Even in the silver lining of the storm-clouds it is apparent that the right development of the corporation is a vital question for business prosperity, if that prosperity is to have any permanency. Now is the time to take another buckle in our belts, study the compass, set our course truer, and prepare for a longer, surer run. The prevailing idea seems to have been that the corporation officials, "captains and lieutenants of industry," were definitely divided into two classes; first, the builders up, creative men, orderly men, planners, and executors of great undertakings, of great enterprises, of great organizations; second, the tearers down, those who by destroying one combination possibly establish another, those who profit by destruction, those who gather in the forced temporary profits from economies brought about by cutting down maintenance so as to show increased earnings and "getting out from under" before the investors are "wise." Experience teaches us there is a third class of equal importance, the confusionists, those who thoroughly tangle up affairs through a maze of multiple corporations, through a labyrinth of combinations of controlling interests. Any worker can choose which of these classes he prefers to join, but he may find it difficult to keep in that class, no matter how earnestly he strives. The game, though only in its infancy, is keenly interesting, the pace set is strenuous, "it is not so much where you are, as which way you are going that counts." This is equally true, for the individual, the labor union, and the corporation.

"Education is the only interest worthy the deep, controlling anxiety of the thoughtful man," so Wendell Phillips told us. Possibly in a broad sense a corporation is only the curriculum of the great live American business university of today.

A composite photograph of the forms of organization of the many corporations has its educational value, because the mastering of economic conditions through common business customs, whether it is pioneer work, development work, or the carrying on of an established enterprise, requires an organization of forces which is briefly the means of accomplishing and adjusting the division of labor. If it is desired to establish in any industry co-operative methods that save waste and increase profits and efficiency, it is necessary to acquire more than the first rough use of the power of organization.

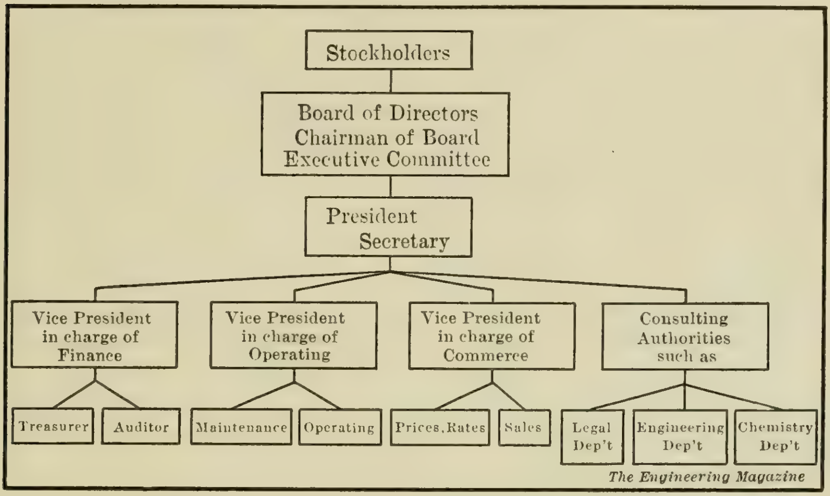
The kinds of work are so many, are so diversified—there is such a wide difference between the ways of the easy-going chap and the ways of the martinet (though both frequently are eminently successful in their management of corporations and men) that at first it would hardly seem possible that the form of organization of the great corporation was already assuming uniform shape.

Like all wholesome American business methods it is a matter of evolution. The better forms have been adopted after careful studies of those already used in doing similar work. These are changed, modified, or revised to meet the conditions and requirements of the particular work; then improved and simplified in order to obtain greater efficiency and to yield larger results. Certain customs are common to many of the successful big corporations. This has gradually brought about a standardization of their forms of organization. Certain fundamental principles are so clearly recognized that they can well be considered as established. These are summed up and expressed in what is known as the "three-column form."

Broadly speaking, there are three distinct branches in the work of all large corporation organizations, Financial, Operating, Commercial; all other positions or departments are either subordinate to these, or are practically consulting authorities. This holds true whether in industrials or railroads, whether in the single corporation or in the series of corporations, and whether the departmental, the bureaucratic, the divisional, or the functional form of organization is used.

A chart of the usual "three-column form" of organization is shown on page 243.

The reason why the three-column form of organization holds true in so many apparently distinctly different kinds of organizations seems to rest upon the underlying principle of an old saying—"Even in a Democracy there must be a leader." This is equally true in carrying on a business. There is always a fixed policy to be carried out, although that policy may be of the *laissez faire* variety. There must be a leader; and furthermore each department, or bureau, must have a head, and these are the lieutenants of the commander in chief. But organization is the antithesis of administration. Under the three-column form of organization the distinction between administration and organization is so clear that it is instinctively understood by every employee.



The Engineering Magazine

TYPICAL ORGANIZATION CHART FOLLOWING THE THREE-COLUMN FORM.

The reason why the financial, operating, and commercial divisions rather than any others are the chief is that the form of organization is not determined by the size of the department, the number of employees, or the volume of work, but by the relative importance of the work and its relationship to the policy of the company. The salient questions of finance, operation, and commerce affect directly the policy of the corporation, and are wholly dependent upon one another. First, the money must be provided. Second, the work must be done. Third, the product must be sold. The best salesman cannot sell unless he has the goods to sell. He knows what the market requires, and what prices he can obtain. He knows how to create selling methods. With that given, the skilled operating man knows how to manufacture what is demanded, or to perform the service that is required. With these two given, the financial man must not only provide for the money but must ascertain beforehand whether the monetary market warrants furnishing or withholding the supply, for financial emergencies must be prepared for well in advance. These are the vital features of any business policy. In the three-column form, the vice-president in charge of finance, the vice-president in charge of operating, the vice-president in charge of commerce, are on an equality; they are peers, and have an associated authority and responsibility.

For this creature of legislation, the corporation, the board of directors is the sovereign power, subject only to the laws of the land. Following the chart, the chairman of the board is the highest official of the corporation. Frequently there is an executive committee of the board of directors. This, however, is usually only a division between the active and inactive directors; possibly it is more courteous to call them "less active directors." Again following the chart, the board of directors, or the executive committee of the board, selects the president who is chosen to carry out their policy. Therefore with a given policy, which he is pledged to follow, the president becomes the chief executive of the corporation. He appoints as his executive staff vice-presidents and consulting authorities, in accordance with what he deems to be the essential requirements of the business or work.

The three-column form of organization makes it possible to separate the work of direction and deliberation from the details of execution, and also makes the executives of the great vital departments parties to these deliberations in their positions of staff officials. In this rests its greatest strength.

By increasing the number of vice-presidential staff positions little or nothing is gained. For instance, it is necessary to have the treasurer's and auditor's departments absolutely separate, for the one is a check upon the other. If both the treasurer and auditor are members of the official staff, and unless they work in wonderful harmony, it means that many questions relative only to these two departments are brought before the staff, seriously increasing its routine work and hampering its work as a whole.

Where there are bureaus of information, these are each under the control of a chief, and may either be staff positions similar to the other consulting authorities, or may be, as is frequently the case, a branch of some specific sub-department.

By decreasing the number of vice-presidential positions the balance between finance, operating and commerce is destroyed. In certain classes of work, or in the early stages of development, any one of the three vital divisions may temporarily overshadow the other two; this, however, in no case alters their relative importance. The corporation may be so small that one official may hold and direct much of the work personally, thereby combining several positions. The ability of the individual together with his capacity for work determines how far this can be successfully carried. For instance, one important railroad had a departmental organization where each department reports to the president. In this case the president practically holds the two positions of president and general manager. Another much more extensive railroad property, which uses the three-column form to its full extent, makes the division the unit, and places all the powers of a general manager in the man at the head of each division. In the series of corporations, the sub-corporation is sometimes the unit. The determination of what the unit may best be is found by carrying the adjustment of responsibility, authority, and the division of labor down through the organization.

What the unit may be has an important bearing on the method of training the men. The career of the young employee is of great moment to a corporation intending to continue its business for any length of time. While there is no patent on ignorance still there are may ignorant men. Men have to be trained and the training has to begin early and extend through many branches of the service in order that they may become competent and efficient. Even when the right material has been developed the best of men cannot produce results under a faulty or vague organization with its inevitable lack of exact responsibility.

The employee must not only know his duties and what is expected of him, but also rather than have obstacles placed in the way he should be able to obtain in a convenient manner, in so far as they affect his work, all the information, statistics, data, and even an understanding of the policy of the company, if he desires to seek them. Unless this is done, it is impossible to avoid duplication of work; or what may be more discouraging, the employee may suddenly find out that half of the work he has done has already been done by others and probably, because they had more time for it, in a more thorough way. Here is where system becomes manifest. Here is where true *esprit du corps* is nurtured or destroyed. Here is where man's originality is crushed, or he gains the joy of achievement. If he is to "play up, play up, and play the game," he must know the rules of that game.

For the individual competition is keen, he must make good every day, all days, month in and month out. If a man resigns, his place is at once filled for there can be no vacancies in a good organization except at the bottom. The pace set is often terrific, heart-breaking, soul-racking, frequently leading only to nervous break-downs. When this occurs the organization is somewhere at fault.

Together with the striving for place, there is the ever increasing pressure for results. An editorial writer in an able article in a recent *Railroad Age Gazette,* speaking of the units of work in use in common railway work, points out how "reputations are made and blasted in terms of these units or 'results' while real causes and effects are lost sight of," but that is the unit of work not of organization and is "another story."

In a series of corporations, especially, the bureaus of information for specific subjects or the departments for particular branches of the business are of inestimable value. Frequently they cause trouble and confusion, showing that the organization is at fault. But under the three-column form of organization they naturally take their proper places, establishing their true relationship to the organization.

Extravagant ceremony and superabundance of "red tape" are often mistaken for system. It is the mistake of being too highly organized, and can defeat the very end for which the organization was created. It is quickly apparent when an organization is too rigid, and the three-column form is undoubtedly the most flexible and elastic of any so far devised. An old privileged workman when told that the new president of his company in a popular address defined "organization as the handmaiden of administration," said "I make no odds about the handmaiden's looks, nor about her merry widow hat, but did he say whether her dress was of red tape?"

When an organization is successful there is no false motion. "The man who does things" is usually the man who can so adjust his organization that he is securing the greatest efficiency, that each man is doing the work in which he is most proficient, and that no two are working at cross purposes or causing duplication of work. The form of organization is among the problems of today, and full success for the head of any organization depends largely upon his ability to choose able lieutenants.

If you turn to the "Official Guide of the Railways" which is the railroad man's handbook, you will find the form of organization and its personnel as shown in the official roster of each road. It is quite remarkable how closely they follow the three-column form of organization. This form, so successfully used by Mr. Cornelius Vanderbilt 2nd on the New York Central and Hudson River Railroad and Mr. Cassatt on the Pennsylvania System, was so skillfully made use of by Mr. Harriman in his great combination of Railroad corporations that Judge Lovett's announcement of the official organization of the Union Pacific merely emphasizes its value. Mr. Julius Kruttschnitt, in a paper read before the New York Railroad Club, shows how thoroughly the organization of the operating division has been worked out, together with its relation to the traffic or commercial division. An interesting point in Mr. Kruttschnitt's paper is his comment regarding the meetings held by the various operating heads of the several properties. "They are legislative bodies assisted by the individual general managers as expert advisers and subject to the approval or veto of the director of maintenance and operation." In this is shown their educational feature or, to use his own expression, "a means of disseminating education to officials."

In the telephone organization only two of the three great divisions of the three-column form of organization are predominant factors, finance and operating. And because there are only two, the power swings like a pendulum from one to the other, for a few years the one dictates and then the other. The commercial division has not been given an equal standing with the other two. It is said that this is because business has always come to them as fast as it could be conveniently taken care of and that they have not had to seek a market except occasionally for a by-product. However that may be, it is true that if a balance in power is to be maintained between finance and operating, it can only be accomplished through the recognition of the commercial division as their peer.

Mr. George W. Perkins in his article "Humanizing A Corporation" in *Appleton's Magazine* wrote:

> The formation of the United States Steel Corporation meant that individual ownership of some of the most prominent steel industries of this country ceased. To men and students of affairs the real problem that faced the new corporation was this: Could men on salaries and wages successfully carry on this vast organization, directed only by other men on salaries—with no proprietorship above them save a vast and scattered body of security holders?

The far-reaching and efficient plan arranged by Mr. Perkins making it possible for those employees who so desired to become shareholders, and in that way partners, so to speak, with the corporation has proved highly successful. The results form a most important chapter in the educational work of organizations.

There are specific kinds of work which require rather remarkable organizations, for instance, that of a great mail-order house, or that of a great engineering undertaking such as the building of the Panama Canal, or that of the "Base Ball Trust" which is said to be the most effectively organized "trust" in this country. There are some forms of organization which show clearly the imprint of West Point training.

The importance of the form of organization is constantly increasing. Certain men of large affairs when considering granting a loan, or taking up an issue of bonds, investigate thoroughly the form of organization to know the relative authority and responsibility of the personnel; whether it is a one-man corporation where one individual dominates, or whether a group of broadly and thoroughly trained men are in charge. What authority have the lieutenants; are they automatons, or men of vigor and character? For the investor next in importance to the story told in the company's balance sheet is the story told in the form of organization.

There is a vast difference between running an organization (or a government) by the mass of employees, such as trade-unionism suggests, and running it through a well-perfected, well-balanced organization which recognizes the rights of the public, the rights of the investors, the rights of the employees. The public as represented in the prices charged for the service they receive, the commercial division; the investors in the dividend and interest returns on their money, the financial division; the employees, in rendering maximum efficiency and receiving credit for work well done, the operating division. Under the well-balanced organization there can be no privileged body of men who can dictate terms to the rest of creation. The true three-column form of organization is for the trust a safety guard against trouble from misguided labor agitation, from retaliatory legislation, from financial dilemma.

The rapid growth and far-reaching consequences of our industrials, our railways, our quasi-public corporations, show the importance of this problem. Involved in it are not only the questions of civil service, of labor and capital, but also of maintaining what Toynbee called "equal industrial opportunity." The individual is the atomic unit of the organization. In recognizing and respecting "the rights of the individual as a person" well balanced industrial organization becomes the corner stone of the science of sociology.

THE "OUTSIDER" AND THE BUSY BUSINESS-MAN.

By William Perry.

The value of the author's suggestions comes from his presence in places where "outside" specialists have been called in to make improvements, and upon his subsequent connection with a leading firm of outsiders. This combined experience puts him in position to judge without prejudice both sides of the question, and to speak with some authority as to the selection of outside talent. THE EDITORS.

ONLY a few years ago, executives began to consider the *possibility* of accepting aid from the "outsider" in manufacturing, administrative, and selling difficulties—the trained outsider whose business is to come in and find means to obtain increased profits or money-making economies.

Since then the question has lost much of its importance, for the business man has seen repeated evidences of "outside" capabilities; he has learned that not one in twenty improvements of machines and methods comes from the "inside."

Today he is face-to-face with a different problem; and the problem is, which outsider to choose.

For the most part, this should depend upon relative experience, and upon what needs to be done in the way of simplifications, improvements, and expansions. As an example, if you are *sure* that nothing more serious than your book-keeping forms need revision, you should call in a systematizer—taking the precaution to select a man whose oldest as well as newest clients speak well of him. Above all, make sure that the systematizer has no interest in the sale of material or supplies which he recommends. When he recommends six forms, question him as to why three are not enough. If he says you need a dozen files, ask him why you cannot do with less. You can generally tell by his replies whether the quantity-recommendations mean anything to him. Failure to be assured of this point risks your being loaded with myriad places for hiding information that ought to be instantly available. Considered according to his limitations, the systematizer is all right; but beyond those limitations he is apt to be no better "guesser" than you yourself.

Perhaps it happens that you are aware of the incapacity of some piece of machinery. In that case you are right in engaging a practical designer to rebuild or develop it. Again, you may know exactly what sales policies to pursue, and what territory to cultivate. Perhaps all you need is a skilled "copy-writer." So long as you are *sure* you know exactly which specific things need correction or improvement, it is not difficult to find the right outsider.

What troubles the business executive is to learn *just which particular conditions will repay investigation and improvement;* just what things will do most (for a given sum invested) toward distancing competition—just what will aid the factory whose delivery promises are notable for their "brittleness."

If you happen to be a man who does not realize how widespread the search has become for the *right sort* of outsiders, you have only to interview five or ten big men in the business world. Some of them will tell you that their firms engage individuals who devote their entire time to effecting improvements in one department after another. Others (wiser ones) will tell you of an arrangement by which they have the pick of the experts composing a firm of "business surgeons" for as many days' service as may be required, paying each month for whatever service has been rendered the month previous, and thus being assured a minimum fee.

A little investigation of this sort will prove to you beyond any doubt that emphatically the outsider is here to stay—and that under the present degree of competition among the different firms of outsiders, each will "stay" only as long as it can make good with clients—not a month longer. Each year's crop of professional outsiders (whether culled from the membership of other similar firms or from the union of individual business-doctors) *remains in business less than one year,* on an average.

Like every other form of professional service, the basis upon which the outsider is successful is merely the basis of giving a liberal return to the client. on the sum invested. There is no other basis that can hope to be permanent. Everyone knows that the value of experience is cumulative, and therefore each additional year of business life multiplies the service-value of an outside firm.

Speaking from a number of years' experience in seeing outsiders employed by firms with which I was connected, and following this with almost five years active work with one of the best known of these outsiders, some few points may be of value to the business man who finds it difficult (or something worse) to maintain profits in the face of growing competition; who sees his manufacturing profit or his selling profit drop off, while rival firms appear to be making money. Whatever value these suggestions may have is enhanced by reason of experience with both sides of the question.

The most important thing to do when selecting an outsider is to *try him out.* Let him demonstrate what he can do and leave you to be the judge of whether the accomplishments represent good value for the fee named. You cannot afford to overreach him in such a matter, for if his service is really valuable, you want the benefit of *all* he can do for you. On the other hand, he cannot get the better of you; for you see what you are buying. After such a demonstration you are prepared to take him on at his regular fee, if he has made good.

Don't handicap him by restricting his work to one department, unless he himself suggests it. Usually the proportion of interdepartmental problems is at least three-fourths of all the problems met with in business. Each method, or process, or handling seems to have an effect upon other methods or processes or handlings almost beyond belief.

Let him go through your place, observing everything—but keeping his observations to himself, for fear of disrupting discipline by half-baked conclusions. Let him make note of improvements wherever he can find them. If he picks out "easy ones," judge him accordingly. If he digs deep, and gives you liberal value for his fee, don't let him go until he has done his utmost for you.

From the very outset, get out of your mind the notion that being in any business for many years teaches one all there is to know about that business. Generally, one is more likely to wear a rut so deep that one cannot see on all sides.

Perhaps you have wondered why these outsiders (if they really *are* such clever fellows) do not make permanent connection with some firm. They would not be satisfied to stay in one place very long. I know a positive genius in the mechanical field who deliberately threw up his contract with the outsiders and set about looking for something new, just because his firm wished him to remain indefinitely on a contract. He said he was sick and tired of the plant, and the city, and the faces he saw every day. He wanted something new. He wanted to analyze new problems, and he wanted to see other lines of business.

It is because of his resemblance to an inventor that the outsider prefers to go from place to place. He enjoys difficult administrative or industrial problems just as an Egyptologist finds pleasure in deciphering fragmentary inscriptions of ancient times.

Experience has proven repeatedly that the outsider does his best work when he changes about. Sometimes he finds a method of handling or inspection in a shoe factory which suggests to him a means of speeding up production or economizing space in some entirely different line of business. (Not long ago, an outsider found that by slightly adapting an addressing machine, he had a rapid and accurate means of attaching textile samples to color cards.)

Keep the outsider with you just as long as he is able to find profitable things to do. Keep him away from your competitors until you are certain of getting the maximum benefit from his inventiveness and experience. Very likely, after his first accomplishments, you may get better results by making the service intermittent; a week or so at a time.

Selecting the outside firm means giving preference to one whose members specialize on certain things. This gives you a distinct advantage, for when you have a machine-designer, or floor-and-wall-space specialist, with you and he sees an opportunity for more efficient handling of shipments or orders, he will give his ideas to another member of his firm, whose specialty it is—and thus instead of the amateur skill of the man who goes beyond his specialty, you will have the professional work of the expert. So, if you have a man with you who is analyzing your sales, or salesmen's efficiencies, or development of territory, he may think of a better way to wrap or pack your goods. If such a man is wise he will have his judgment affirmed by some of his associates, who will advise him concerning practicability and comparative expense of the new method.

Some suggestions which come from non-technical men are very profitable, but only after they are worked out. Knowing little or nothing of the technique, an expert may sometimes think out a plan along lines supposed before to be impossible. For example, printer's ink has been packed for years in a certain way. A firm of outsiders had two or three of its men with a prominent publishing house. They found a large amount of ink being lost because of irregular and left-overnight runs. They didn't see any other way of packing the ink. But another member of the firm (a selling-and-distribution man) suggested a radical change in the ink-container. Not knowing much of mechanics, he was not able to work it out; so back went the suggestion to the technical men, with the result that they found in the open market all the material needed to give the client advantage of the suggestion. As a result thousands of dollars worth of ink were saved. No individual outsider, working alone, would have accomplished the improvement.

When the outsider is a "narrow" man, who seeks to do it all himself without calling in assistance, the client is invariably the loser.

If you happen to have several stores, or factories, or offices, you will do well to put it up to the outsider to say which one he will take up for demonstration. If he is thoroughly alive to his opportunities, he will choose the best-managed one, because if he can be of service there he is sure to be of even greater service in the case of the others. If he does *not* choose the best one, it is pretty good evidence that he is looking for something easy—and that in turn suggests lack of confidence in himself.

Having decided which firm you will choose, and proved its abilities through demonstration (both as to analysis of existing conditions and creative ability in improving them), the next step is to prepare your working forces and sub-executives for their coming. Do not do as one eastern man did, on an occasion where I was called on to locate sales troubles and build up sales profits. After telling his salesmen to wait beyond their usual leaving time, he brought the outsider before them with an introduction like this: "This is Mr. So-and-so. He is coming in to find out why you salesmen don't sell more goods. Look out, or he'll get your scalps!"

Imagine that as an introduction to men who had kept locked up in their heads information that their house needed. The outsider knew that the head of the house intended to be humorous, but a single glance at the faces of the men told him they didn't appreciate the humor. It meant plain bread-and-butter to them.

Do not make that sort of mistake when you introduce the outsider. Tell your people instead that he comes to co-operate with the house and the working-forces; not with *one*, but with *both*. Tell them the outsider will do *some* things that have been in mind for quite a while. and other things that result from the analysis of conditions to be made. Ask them to help him in every way; and explain that by doing so they will be helping themselves through helping you. Say that the outsider has requested permission to talk to them one by one, so as to get their ideas, as well as the ideas of the firm. This will go a long way toward facilitating the work; for it is always pleasant (and only human) to learn that one's opinion is sought for.

Such an introduction will not only make the outsider's task pleasanter, but he can thus perform his work more quickly—and that means shortening the service-fee you pay him.

Some executives think it unnecessary that the outsider should get the working-forces' point of view. They are wrong; it is essentially necessary, if work of permanent value is to be done. You would not think of going to your lawyer and telling him only half the truth, nor to your doctor. They could not do their best for you on half-truths. Neither can the outsider.

Of course your people will "knock the house." Expect it. What do you care? Some of the "knocks" will be founded upon prejudice, no doubt; others on envy. But out of the lot will come a few that are honest criticisms of existing faults you do not know about—or knowing, do not realize the seriousness or costliness of not attending to them. They may concern the management of the firm or its products, or its treatment of customers or employees. Those "knocks" which it is most necessary you should know are apt to be kept from you by your people; for fear of losing their jobs, or else perhaps for fear their criticism will be taken as *lese majesté.*

Usually, like individuals, business enterprises profit by "knocks" just as surely as by "boosts." So be prepared for them; expect some of them to hit you hard, for your own good. Leave it to the outsider to judge which is which until he makes his report or recommendations.

There is another thing. Do not expect that every recommendation of the outsider will be a stroke of genius. If he is sincere and thorough in his work, he is likely to suggest small improvements as well as large ones. Measure his work not by the poorest recommendation, but by the total value of the good ones.

Suppose a quarter of his suggestions contain nothing of marked value. What difference does it make, if the remainder are worth enough to make the service-fee well invested? Suppose a full half of his suggestions are of limited worth. That merely shows he has done all in his power to make good with you. If he was looking for a personal record for brilliancy, he might ignore all except the spectacular improvements. But you know how few spectacular things occur in the steady grind of business. Take outside recommendations on the same basis. If he is the right sort of outsider, he will give you the benefit of everything which he believes will help you. Often it happens that an idea which is offered almost apologetically contains the germ of a radical, or even revolutionary, improvement; and when the outsider is one who is inclined to "play to the gallery" he may withhold the incomplete suggestion for fear of marring his personal record.

There are "sacrifice hits" in methodizing as well as in baseball, and sometimes they are quite as productive of good "to the team."

So encourage the outsider to suggest *all* the ideas and improvements that seem good to him. Some may need development that can be made only by a man with the technique of the business at his command. Yet the man who possesses *nothing but technical knowledge* of the line would scarcely think of recommendations outside the customs and practices of that line.

Consider carefully and separately every recommendation—first on its own merits, and then in *combination with the other recommendations.* Talk each one over with the outsider, and get his point of view. Find out how he expects the recommendation to be valuable to your business. Then be content if three, or two, or even one out of every five recommendations proves both profitable and important. Do not think of the others as surplusage: think of them instead as good measure—bonus—utmost willingness on the outsider's part to serve you well. The most capable outsider will now and then make unimportant or doubtful suggestions. Reckon his value not in them, but in the remainder.

And just one more suggestion. When you get the outsider's recommendations, do not skim them over. Go into each one carefully. Perhaps a suggested plan or method may not appeal to you at first; but don't turn it down out of hand. Remember it is being presented together with a number of others, and you must judge of the whole result, rather than the prospective value of any single recommendation. The outsider is risking his professional reputation in what he recommends to you. In return, you owe him the benefit of the doubt as to feasibility of any suggestion that is to be used in connection with various other suggestions, for the good of the business as a whole.

Make up your mind which recommendations you can have your own people carry out; leave the rest to the outsider. The especial advantage of having the outsider install his own improvements is that he may have opportunity to utilize the *improvements on the improvements* which suggest themselves to him during installation. Trust to his personal pride to do his best to give you the benefit of these re-improvements; for he knows that his future reputation rests entirely upon the efficiency of past work. The same pride will prevent his installing anything that will not operate practically, even though he may have made the error of recommending it in a report.

Make up your mind that the outsider is here to stay. You cannot afford to overlook the benefits he can obtain for you, any more than you can afford to ignore telephones, or typewriters, or modern automatic machinery.

Select your outsider with care. Look up his references. Don't bother to ask *what* he did for them. They may not want to tell you; and even if they did, that would be no proof of his ability to serve *you* with equal profit. Ask the references just one question. "Was So-and-so's service a good investment for you?" That's all. Then when you have good words from several *diverse* lines of business (thus testing his creative ability) try out your man. If you find him painstaking and inventive and clever, *work with him*; stimulate him to do his best; put him on his mettle; let him do his utmost for you before you release him to your competitors.

In short, if you would get his best thought, make an associate of him—not an employee.

EDITORIAL COMMENT

Co-operation, Competition, Efficiency.

JUDGE GARY'S defense and advocacy of co-operation as an industrial policy, contained in his address as first President of the American Iron & Steel Institute, has been widely discussed. To most commentators the most important suggestion seems to be that (emphasized by the conditions under which the address was delivered) of closer international accord between steel manufacturers of the world. The significance generally discerned or noted is limited to the external relations of the steel trade—its attitude toward and power over the consumer. Considering its circumstances, however, the United States Steel Corporation has been probably as benevolent a despot as any created by the passing era of gigantic consolidations; and if the present management or its spirit remain in control it is not likely the policy would be materially changed or the treatment of the steel-using public would become materially different, even if the closest co-operation were established between British and American steel producers.

The question which seems to have missed the notice it deserves is what will be the internal result of long continuance of the policy of co-operation? Can the steel industry, under conditions approximating ever closer to monopoly, retain its energy of evolution—will it remain as it was in the past an industry of incessant achievement, of progress in methods and equipment, progress in technology, multiplication of output through improvements in practice; or will it become an inert Colossus—gigantic, but stationary? To revert to Dr. Orton's opinion quoted by Mr. Mulford elsewhere in this issue, *can* "the majority of masters" in an industry achieve the results that the autocrat achieved? Can organization, however able and conscientious, carry forward industrial progress on the curve traced by individualism during the past half-century?

It is too soon yet to tell, for the impulse given by individualism and competition is still active. The first advantages accruing through the saving of the wastes caused by competition also complicate measurement of the total result. But if history is a guide, consolidation, monopoly, organization to carry on this monopoly, standardization of methods as a corollary of organization—all lead eventually to loss of momentum, stagnation, ossification.

The new philosophy, however, that may change the whole trend and termination of industry under its newer influences is efficiency. Under this energizing stimulus, without the warfare and waste accompanying competition, a like progress may be attained, as Harrington Emerson has pointed out, "not by individual striving, but solely by establishing, from all the accumulated and available wisdom of the world, staff-knowledge standards for each act—by carrying staff standards into effect through directing line organization; through rewards for individual excellence, persuading the individual to accept staff standards, to accept line direction and control, and under this double guidance to do his own uttermost best."

Engineering by Commission.

FAILURE to secure bids for private construction of the proposed New York subways is the outcome of conditions that have come into existence very swiftly, and with rapidly rising influence will affect the future of material development.

Exasperated at being exploited by individuals or individualized corporations, the people have asserted their yet inchoate power to control the "interests;" and the interests, uncertain how long the storm will last or in what direction it will blow, are sullenly guarding the structures reared on old foundations, and refusing new ventures. As the country is not yet ready for wholesale municipal or state socialism—the construction by the community of its own industrial, power, or transportation projects—there is marked stagnation. It is not an episode, but a preliminary experience in a new order of things. For the present, however, it has the curious and unfortunate effect of indirectly strengthening the position of old monopolies or part monopolies by discouraging the launch of new and at least partly competitive undertakings.

Granting the Public Service Commission all possible sincerity of purpose and moral standing, nevertheless (largely because it is a public commission) it has handled the affairs committed to it with non-success unheard of among industrial or commercial corporations—a non-success of method, indeed, that has brought upon the Commission the singular visitation of public censure by a great independent engineering institution and by the general consensus of technical or other experienced criticism. And it has demonstrated little except that when, under fear of favoring industrial capital, construction opportunity is made unattractive, the public is left to do for itself the unprofitable thing.

A Freak of Fortune.

THE voyage of the airship "America" may not unjustifiably be classed with the trapeze act without a net, "the dip of death," or any other spectacle, in which the performer throws dice with death and wins. The intense interest shown in all such events by the masses is perhaps not so cruel as is often assumed. Granted that it is only a step, if so far, from the delight of Roman holiday-makers in a gladiatorial combat; yet the cardinal interest, after all, may not be the actual or possible blood and slaughter, but the triumph of the performer, or of one of the performers, over the Destroyer of Life. Somewhere in the subconsciousness of each of us is the realization that moment by moment a hair line only is drawn between us and the grave. When we see a fellow human recklessly stretch this line to its supposed breaking point, and remain unscathed on this side of it, we (also subconsciously) take to ourselves a certain sense of immunity, or at least a greater security of life. Fallacious it may be; yet here is perhaps the fundamental reason for the fascination of perilous achievements.

From a technical point of view, the attempt was utterly reprehensible and the result a mortifying series of failures to realize anything resembling calculated performances. Indeed, in a province where determinations must be largely empirical, the attempt was made on assumptions wholly theoretical and untested by trial. By such data as are available many of the elements of the project were apparently unsound. It was wholly unproved that the "dirigible" could be directed under probable conditions of mid-Atlantic weather. Zeppelin's experiences indicated that it could neither be directed nor maintained afloat for the time necessary to drift across the ocean. Common-sense suggested that a dragging tail relatively enormously heavy and varyingly submerged in a rough sea would not be an "equilibrator" but decidedly the reverse. Success under peculiarly favorable conditions was not an impossible contingency, but would have proved nothing of value. Mr. Wellman, his companions, and a sympathetic world are to be congratulated that by an almost incalculably fortunate chance there was no tragedy. Atlantic shipping is to be congratulated that the string of flimsy gasolene tanks was not dragged destructively across some luckless vessel, with results too hideous to contemplate. In brief, we may thank God it was no worse.

REVIEW OF THE ENGINEERING PRESS.

"THE WORLD IS ITS FIELD"

RADIATION FROM GASEOUS EXPLOSIONS.

AN INVESTIGATION OF THE HEAT FLOW IN GAS-ENGINE CYLINDERS DUE TO RADIATION.

Bertram Hopkinson—British Association for the Advancement of Science.

THE third report of the Gaseous Explosions Committee of the British Association for the Advancement of Science, presented by Professor Bertram Hopkinson at the recent meeting of the Association in Sheffield, continues the record of the highly important research on gaseous explosions, with special reference to temperature, which was begun in 1907. A year ago we gave in these columns a brief *résumé* of the contents of the first and second reports, and a lucid exposition, from the pen of Dugald Clerk, of the immense practical utility of the data accumulated in the course of the investigation in the solution of the many urgent problems connected with the design of gas engines. These reports gave, it will be recalled, the first accurate set of data by which the temperature of the gases could be calculated from a knowledge of the initial condition of the gas and the amount of heat energy imparted to it by explosion or otherwise. During the session of 1909-1910 the experimental work of the Committee has been continued, by Dugald Clerk, who has continued his measurements of the volumetric heats of air and CO_2 by the method of adiabatic compression; by Prof. H. B. Dixon, who has investigated the temperatures of hydrogen and oxygen produced by adiabatic compression; by Prof. Dalby, who has made measurements by means of an orifice of the air supply to a gas engine; and by Prof. Coker, who will shortly publish further measurements of the temperatures in a gas-engine cylinder. The main work of the Committee, however, has been on the subject of radiation, and Professor Hopkinson's report, briefly abstracted below, is confined to the discussion of this single factor in heat flow.

"In the first and second reports of the Committee reference was made to the part played by radiation in the cooling of the products of an explosion, and to its bearing on the measurements of volumetric and specific heat with which those reports were principally concerned. The general question of radiation from heated gases has, however, from the point of view of the Committee, an interest and importance of its own, which are sufficient to justify a detailed study of it in its wider aspects. Radiation plays a part comparable with that of conduction in determining the heat flow from the gas to the cylinder walls in the gas engine, and it is this flow of heat which is the most important peculiarity of the gas engine, and to which are chiefly due the leading characteristics of its design. The difficulties which the designer has to meet are due, in the main, to the stresses set up by the temperature gradients which are necessary to sustain the flow of heat. In the present state of the art it is probable that the most important service which science could render to the gas-engine constructor would be to establish definitely the principles upon which depend the heat flow from hot gases into cold metal and thus to enable him to predict the effect upon heat flow of changes in the temperature, density, or composition of the charge, and in the state of the cylinder walls."

As noted above, Professor Hopkinson's report does not attempt to deal with the whole of this large question, but with the single subject of radiation. The subject is a wide one. It has excited much attention among physicists and chemists, and on several important points agreement has not yet been reached. No attempt is made in the report to do more than state briefly the experimental facts, and to define the issues which have been raised with regard to the explanation of these facts. Professor Hopkinson points out that although the discussions on the Siemens furnace and the work of Helmholtz show that the idea that a flame, even if non-luminous, might radiate large amounts of heat, was a familiar one as much as twenty years ago, its possible importance in explaining loss of heat during and after a gaseous explosion, and in determining the heat flow in a gas engine, does not appear to have been appreciated until quite recently. Professor Callendar was probably the first to draw attention to its significance in this connection; he was led to study the subject by his work on the efficiency of the gasoline engine. The particular matter which attracted Callendar's attention was the effect of speed on thermal efficiency. His experiments showed that a part of the loss of efficiency in an internal-combustion motor, as compared with the corresponding air cycle, was independent of the speed at which the engine was run. In 1906 he reported the discovery that a non-luminous Bunsen flame will radiate 15 to 20 per cent. of its heat of combustion, and expressed the opinion that the loss from this cause in a closed vessel explosion would be of the same order.

"Another phenomenon difficult to explain, except as the result of radiation, is the effect of strength of mixture on heat loss. The following table shows some results obtained in tests on a 40 horse power gas engine:—

Percentage of gas in cylinder contents, per cent....................	8.5	11.0
Total heat loss per minute, B. th. u.	1,510	2,300
Total heat loss as percentage of total heat supply, per cent......	29	34
Temperature of piston, degrees C..	300	430

It will be observed that the proportion of heat loss to the walls increases very materially as the strength of the mixture is increased. If the transfer of heat were wholly due to conduction it might be expected that the percentage of heat loss would rather diminish with increase of charge, because the temperature with the stronger mixture should be relatively less on account of the increase of volumetric heat. The existence of radiation, however, which increases more rapidly in proportion to the temperature, would account for the increased heat flow. The practical importance of questions of this kind is illustrated by these figures, from which it appears that the piston is 50 per cent. hotter, though the charge of gas is increased only 30 per cent.

More direct evidence of the importance of radiation is furnished by experiments on the effect of the surface of the walls. Recently an explosion vessel has been plated with silver on the inner surface, and the results have been compared after exploding identical mixtures, first when the lining was highly polished, and second when it was blackened over with lamp black. It was found that by highly polishing the interior of the vessel the maximum pressure reached could be increased 3 per cent., and the subsequent rate of cooling during its earlier stages reduced by about one-third. These experiments leave no doubt of the reality and of the practical importance of radiation as a factor in determining the heat loss in the gas-engine. By means of a bolometer, Professor Hopkinson has recently made measurements of the radiation emitted in the course of an explosion in a closed vessel and subsequent cooling. He found that the total heat radiated during the explosion of a 15 per cent. mixture of coal gas and air and the subsequent cooling amounted to over 22 per cent. of the whole heat of combustion. The radiation which had been received at the moment of maximum pressure amounted to 3 per cent., and it continued, at a diminishing rate, for a long period. It was still perceptible half a second after maximum pressure, when the gas temperature had fallen to 1,000 degrees C.

There is no reason to suppose that the radiation in the gas-engine cylinder differs materially as regards its quality or origin from that emitted by an open flame. In a very complete spectroscopic analysis of the radiation from different kinds of flame, the results of which were later confirmed by Helmholtz, Julius found that in all flames producing both CO_2 and steam most of the radiation was concentrated into two bands. It is most probable that the radiation in an explosion consists almost entirely of the same two bands as are emitted by the Bunsen flame; it follows, therefore, that the luminosity of the flame in an explosion or in a gas engine accounts for but little of the energy which it radiates. Much difference of opinion exists as to the physical interpretation of these facts. The issues in the controversy can be stated conveniently in terms of the molecular theory, to a statement of which Professor Hopkinson devoted considerable space. The issues are not merely of theoretical interest, however, but are in large measure issues of fact capable of being tested by experiment, and the answers to important practical questions may depend on the manner in which they are settled.

"The radiation from hot gas is complicated by the fact that the gas is to a considerable extent transparent to its own radiation. The radiation emitted, therefore, depends upon the thickness of the layer of gas, instead of being purely a surface phenomenon, as in the case of a solid body. This property, besides being of great physical interest, is important from the point of view of the gas-engine designer because upon it depends, or may depend, the relative magnitude of radiation losses in engines or explosion vessels of different sizes. The transparency of flames is well illustrated by some experiments which Professor Callendar has been making. . . . . The general result of these experiments is to show that flames of a diameter of 3 centimetres or less burning at atmospheric pressure emit radiation approximately in proportion to the volume. If the diameter be increased beyond that figure the radiation will also increase, but not in proportion to the volume of the flames." The flames met with in a gas engine or in explosion vessels differ from open flames such as can readily be produced in the laboratory, both in respect of lateral extension and also in respect of density. It does not seem possible from theoretical considerations to determine the effect of these two factors with sufficient accuracy to enable any quantitative inference as to radiation in the gas engine to be drawn from laboratory experiments on flames. There is no reason to doubt, however, that the character and amount of the radiation from CO_2 and steam at high temperatures will change with the density. Such direct measurements as have been made of the radiation after a closed vessel explosion suggest that the flame is more transparent than might be inferred from the experiments on open flames. Recent experiments suggest that a thickness of 30 centimetres of flame can transmit much of the radiation which it emits. The density of the gas in that case was atmospheric, and the 30 centimetres thickness in the explosion vessel would be equivalent to perhaps 150 centimetres of open flame if absorption were simply proportional to density. According to Professor Callendar's experiment, such a thickness would be almost completely opaque. It is possible that the lateral extension is sufficient to account for this result. The open flame should be a cylindrical mass, of dimensions 150 centimetres by 150 centimetres, instead of a long strip with a cross section of 3 centimetres, in order to make the cases strictly comparable.

In an appendix Prof. H. L. Callendar discusses the effect of radiation loss on the thermal efficiency. He states that although it is not possible to calculate the absolute magnitude of the radiation loss in a motor, or to deduce from it the relative loss of thermal efficiency, it is not difficult to see in what manner this loss should vary with flame temperature and with linear dimensions of the cylinder. He discusses the subject under various heads, and describes his experiments in some detail. There is also an appendix by Professor Hopkinson on radiation in a gaseous explosion, and another appendix contains abstracts from various papers relating to the application of heat radiation from luminous flames to Siemens' regenerating furnaces.

THE BRIQUETTING OF IRON ORES.

A REVIEW OF THE PRINCIPLES AND METHODS OF BRIQUETTING FINE IRON ORE AND BLAST-FURNACE FLUE DUST.

Chevalier C. de Schwarz—Iron and Steel Institute.

THE problem of fine-ore and flue-dust utilization in iron metallurgy increases in importance year by year. In America, the principal incentive to the wide adoption of briquetting processes in European iron works—the growing scarcity of iron ore in general and lump ore in particular—is not yet seriously felt. Other conditions, however, of no slight importance, combine to make the briquetting plant a desirable, and in some cases a necessary, adjunct to the blast-furnace equipment. The use of improved and more effective explosives in mining has increased the percentage of small and dust ore produced, while at the same time the increased height and higher blast pressure of the modern blast furnace have aggravated the difficulty of dealing with a finely divided charge. On this account, and further because of the growing use of blast-furnace gas for the operation of gas engines, the modern iron works is absolutely limited to the use of ores free from small particles and dust. It is significant of the new conditions that a large plant for the briquetting of flue dust, the first installation in America on the Gröndal system, is now being installed at the Duquesne works of the Carnegie Steel Company.

Briquetting processes are described in a paper read by the Chevalier C. de Schwarz at the recent meeting **of** the Iron and Steel Institute. It is quite apparent that we are still very far from having a perfect and universally applicable system. Some methods have proved successful only for certain kinds of ore, or in purely local conditions. Experience has shown that the method to be adopted must be designed to suit not only the physical condition of the ore but also its chemical composition. Most of the methods proposed have proved too expensive, directly in first and operating costs, and indirectly in the reduction of the iron content of the ore by the addition of binding material.

The conditions which iron-ore briquettes should fulfil are seven: (1) they must be capable of resisting a mechanical pressure of not less than 2,000 pounds per square inch, and when dropped from a height on a cast-iron plate, they must not fall into dust, although they may break in pieces; (2) they must resist heat; at 900 degrees C. they may commence to sinter but must not disintegrate into small fragments; (3) they must be capable of being placed in water for a considerable time without softening; (4) they must resist the action of steam at 150 degrees C. without crumbling; (5) they must be to a certain extent porous, in order to allow the carbon monoxide in the blast furnace to penetrate the interior of the briquette and to exercise its beneficial reducing influence; the porosity is tested by placing the dried briquettes for about 25 minutes in water; they should absorb in this time not less than 12½ to 16 per cent. of water, according to the nature of the ore; (6) if a binding medium is used, it should not contain impurities, such as sulphur or arsenic, in quantities likely to injure the quality of the pig iron produced; and finally, (7) the cost of producing briquettes should not exceed the difference in price between lump ore and fine ore.

Briquetting processes may be divided into those in which a binding medium is used, and those in which no binding medium is used; and the first class may be subdivided according to whether the binding medium is inorganic or organic. Dealing first with the class of processes in which no binding medium is used, except in the case of ores which contain a certain percentage of clay, in itself a binding medium, the briquettes have to be heated at considerable expense. The satisfactory results obtained in briquetting bean ore and clay iron stone by pressure alone at Kertsch, in Russia, and Ilsede, in Germany, naturally suggested the use of clay as a cheap binding medium which would do away with the necessity of heating the briquettes. It has been found, however, that so comparatively large a percentage of clay is necessary as unduly to reduce the iron content of the ore, besides requiring additional limestone in the furnace, and this method of briquetting has been abandoned except in localities where ferruginous clay is available. The attempt to avoid both the use of binding medium and the necessity of heating the briquettes by employing very high pressure, up to 11,000 pounds per square inch, has not been successful; the briquettes made in this way, while firm and strong, are too dense, and crumble when exposed to heat.

Of the processes of briquetting without binding medium, by heating the briquettes after they have left the press, the Gröndal has proved most successful for magnetic ores. The concentrates from magnetic separators, containing from 67 to 71 per cent. of iron, are moistened and made into round-edged briquettes about 6 inches square and 2½ inches thick. The briquettes, set on edge on small iron wagons, are placed in a furnace heated by producer and blast-furnace gases and supplied with a sufficient quantity of heated and compressed air to produce a strongly oxidizing flame, whereby the magnetic ore (Fe_3O_4) is oxidized to peroxide of iron (Fe_2O_3), while at the same time the sulphur is considerably reduced. The capacity of a furnace 150 feet long and 5½ feet wide is about 200 tons of briquettes per week, at a cost, exclusive of general expenses and royalties, of 3s. 4d. per ton. The briquettes are hard and porous and are well suited to the blast furnace.

The comparatively high cost of the Gröndal process has prevented its adoption to any great extent outside of Sweden. In Sweden, however, because of its special adaptability to the prevailing iron-making conditions, the Gröndal process is widely employed, the 27 furnaces now in operation having an annual output of 300,000 tons. Swedish iron-making practice is based almost entirely on the use of charcoal in the blast furnace. The acid slag of charcoal furnaces does not absorb sulphur, but allows nearly all the sulphur in the ore to pass into the pig iron. On this account, Swedish iron masters object to the use of ore containing more than 0.015 per cent. of sulphur; the popularity of the Gröndal process is largely due to the expulsion of a large proportion of the sulphur remaining in the concentrates by the oxidizing flame and high temperature (1,400 degrees C.) of the briquetting furnace. Although the percentage of iron in the briquettes is somewhat reduced by the transformation of the magnetic oxide into peroxide of iron, this disadvantage is more than compensated for by the removal of the sulphur, and also by the fact that the reduction of the peroxide in the blast furnace is accomplished with less fuel than is required to reduce magnetic oxide. The growing scarcity of charcoal in Sweden is another consideration in favor of the use of the Gröndal process. Taking equal weights and percentages of iron in each case, briquettes of magnetic oxide require 300 pounds of charcoal more per ton of pig iron than briquettes of peroxide, representing an additional cost of about 6s. 6d. per ton of pig iron.

The use of briquettes made of concentrates directly in the open-hearth furnace, as a decarburizing and enriching addition to the molten metal, has been suggested. The concentrates made by the Gröndal process in Swedish practice amply fulfil the conditions of quality and purity established for ore additions to the open-hearth furnace charge. It is unnecessary, therefore, in making briquettes for this purpose to heat them up to 1,400 degrees C. for the complete expulsion of the sulphur, nor is it necessary either to oxidize the iron from Fe_3O_4 to Fe_2O_3 or to make the briquettes porous. The briquettes may be compressed at a considerably higher pressure than when designed for blast-furnace charging, and the heating need not be carried above 800 to 900 degrees C., at which temperature Fe_3O_4 commences to sinter. Briquettes for use in the open-hearth furnace are considerably cheaper and richer in iron than those used in blast-furnace practice.

In order to avoid the cost of briquetting, an agglomeration process has been devised which seems to be of especial value in cases where the agglomeration can be advantageously combined with a roasting action, as in the case of spathic ore, brown ore, or iron ore containing a high percentage of sulphur. The process is carried out in a rotary kiln. Coke dust mixed with the fine-grained ore to be agglomerated reduces a part of the Fe_2O_3 to FeO, at once enriching the ore in iron and reducing the temperature necessary for agglomeration. The process, however, presents two serious difficulties: first, the difficulty of regulating the temperature so as to produce sintering without melting, and, second, the tendency of the ore, as soon as it commences to agglomerate, to form scaffolds by adhering to the inner fireproof lining of the furnace. The difficulties are more pronounced when coal dust is employed for heating the furnace, because the tendency of the ore to form scaffolds is increased by the addition of the silica and alumina in the ash. The use of gas fuel may remove this difficulty, and at the same time may make the regulation of the temperature a more simple matter.

One of the earliest materials used as a binding medium for iron-ore briquettes was slaked lime; it has been found that satisfactory briquettes can be made when the lime is mixed with some granulated basic slag, but for various reasons the process has been little used. The 7 or 8 per cent. of binding material necessary considerably reduces the percentage of iron in the briquettes, but the most serious drawback of the process is the expense of space and labor for the storage of the briquettes in the open air until the calcium oxide absorbs sufficient carbon dioxide to prevent the briquettes from crumbling in the blast furnace through the dehydration of the hydrate of lime.

Burnt lime, gypsum, and cement also have been tried, but without success. A mixture of sand and slaked lime has been more satisfactory. The briquettes, consisting of fine-grained ore intimately mixed with 6 per cent. of these materials in equal proportions, are exposed for some hours to the action of superheated steam under pressure, after which they are ready for the blast furnace. The silica is changed by this treatment from the insoluble to the soluble condition, ready for combination. Technically the process is very successful, but the high cost both of plant and of operation has prevented its wide adoption. A similar method of briquetting, based on the same principle, uses basic blast-furnace slag as binding medium, but the quantity of binder required to make a satisfactory briquette (10 per cent.) unduly reduces the percentage of iron. Spathic iron ore mixed with lime is successfully used in the same manner, but this process also is too expensive for wide adoption. This process is based on the fact that under steam pressure the mixture is changed into hydrated ferrous oxide and carbonate of lime. The former, being of a gelatinous nature, serves as a binding medium and changes later on into hydrated sesquioxide of iron. The spathic ore and lime are mixed in the proportion of two to one, and 15 per cent. of this mixture is added to the ore to form the briquettes. When spathic ore alone is to be briquetted, an addition of 6 per cent. of lime alone is sufficient.

The success achieved in briquetting blast-furnace flue dust is largely due to the fact that the dust itself, composed, like cement, of lime, alumina, and soluble silica, possesses hydrualic properties. By the addition of certain salts, such as the chlorides of magnesium and calcium, green vitriol, or sulphuric or hydrochloric acids, these hydraulic properties may be intensified to such a degree that they may be utilized for the formation of briquettes. Of these materials, chloride of magnesium, used in the Schumacher process, has been found to be the most suitable, because of both its cheapness and its freedom from deleterious elements. The Schumacher process has given very satisfactory results, both technically and commercially. It may be pointed out here that flue dust must be used almost immediately after its removal from the catchers, and that, like cement, it must be protected against humidity before briquetting. Basic blast-furnace slag which has been exposed to steam pressure, to change the silica from the insoluble to the soluble state, is another binding medium which produces satisfactory briquettes of flue dust. The silica of the slag combines with the lime of the dust to form a kind of cement; in case the quantity of lime in the dust is insufficient, another 4 or 4½ per cent. is added. This process, however, is open to the objection that the 8 to 12 per cent. of binding material used reduces the iron content of the briquettes to a point where briquetting becomes unprofitable.

Of organic material, waste lye, a by-product of the manufacture of sulphide cellulose, and molasses have been used for briquetting both flue dust and ores. About 6 per cent. of the lye, concentrated to a sort of pitch, is intimately mixed with the dust or ore and the mixture pressed into briquettes under a pressure of about 9,000 pounds per square inch. The briquettes are entirely satisfactory, but the cost of the binding medium is too high to promise financial success to the process. Molasses has been used for briquetting the ferri-ferrous residues of the aniline manufacturing process, as well as for the briquetting of flue dust and ore. One part by volume of cheap molasses, two parts of Kieselguhr, 0.4 parts of carnalite, and 100 parts of ore, from the briquette mixture. The briquettes, after drying in the open air, are heated in an annular furnace to 1,000 degrees C., at which temperature they begin to sinter and harden. For briquetting aniline by-products, which contain about 67 per cent. of iron, the process is entirely practicable; for other purposes it is entirely too expensive.

In conclusion, M. de Schwarz gives some data of the costs of the various processes described. The Kertsch and Ilsede methods cost about 1s. per ton of briquettes; the Gröndal process, 4s. 8d. including royalty; the Schumacher process, which has given the best financial results for flue dust, 1s. 8d. per ton without royalty; the less important processes, from 2s. 6d. to 3s. 9d. per ton. M. de Schwarz doubts that a universal process fulfilling the conditions enumerated at the beginning of this review will ever be invented. He mentions, however, in his concluding paragraph, a new process to be used at a Belgian works, which gives promise of being more economical than any yet introduced. It is said that the binding medium, of which 2½ to 4½ per cent. is used, costs about 16s. per ton. The first cost of plant is about £2,500, and the cost of manufacture, including general expenses, about 1s. 6d. per ton. The briquettes fulfil all the conditions referred to, and are ready for use within 24 to 36 hours after leaving the press, without heating or further treatment. The method is applicable to mill scale, as well as to fine ores. Further details of this very promising process will be awaited with interest.

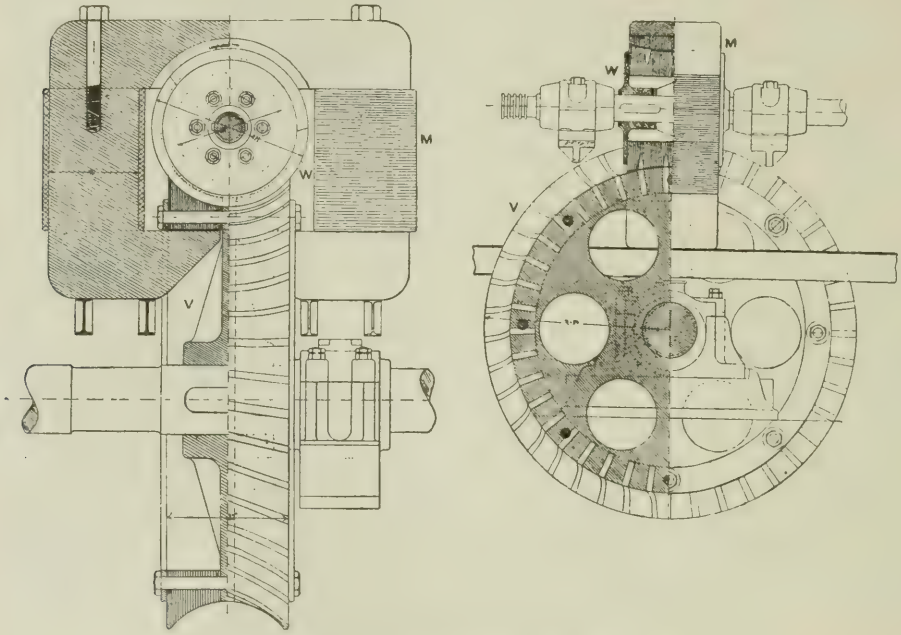
AN ELECTRO-MAGNETIC TRANSMISSION FOR MARINE TURBINES.

A BRIEF DESCRIPTION OF A NEW GEAR FOR SPEED REDUCTION AND POWER TRANSMISSION IN MARINE TURBINE PROPULSION.

Jules Lecoche—Institute of Marine Engineers.

IT is just a year since we described in these columns the Melville-Macalpine-Westinghouse double-helical spur gear for transmitting to the propeller shaft at a reduced speed the power of marine steam turbines. Later we described the Föttinger hydraulic gear designed for the same purpose, and more recently still another mechanical gear, the invention of the Hon. C. A. Parsons. Another solution of the marine turbine problem is now offered by Jules Lecoche, who has described an electro-magnetic system of power transmission and speed reduction, invented by him, at a recent meeting of the Institute of Marine Engineers. The diagram and data below are taken from a reprint of his paper in the *Mechanical Engineer* for September 23.

According to M. Lecoche, the gear is especially applicable to the combination of reciprocating engine and low-pressure turbine, which experience has shown to be the most economical system of marine propulsion. "The diagrams show a magnetic frictionless gear of the screw type for an exhaust-steam turbine of 300 brake horse power running at 3,000 revolutions per minute; through this gear the power of the turbine is transmitted to the main propeller shaft driven by the reciprocating engine at a speed of 75 revolutions per minute. Such a high-speed reduction is possible in this case, owing to the fact that the absence of friction between the working parts allows such high circumferential velocities as would be quite impracticable with mechanical gearing; besides, apart from the bearings, there is no need for lubrication, and this is a point not to be despised. Unlike an electric motor, the revolving parts of the magnetic gear carry no winding whatever, so that the empty slots and helical grooves of both wheel and worm provide for a perfect cooling. The three main parts of the gear are the field magnet M, the laminated worm W, the wheel V.



SECTIONS OF A 300 HORSE-POWER MAGNETIC GEAR.

"The field magnet, made of cast steel of high magnetic permeability, is of the Manchester type; its top pole-piece is laminated in order to prevent losses and heating from hysteresis and Foucault currents. The coils are wound with high conductivity copper wire properly insulated. The worm is made up of iron stampings fixed concentrically on two cast-iron spiders, in exactly the same way as the armature core of a motor or dynamo. One end of the worm shaft is coupled to the turbine. The end-thrust is either entirely or partially balanced by that of the turbine. A thrust-bearing is shown at the other end of the shaft to take the unbalanced thrust. The wheel, being subjected to a side-thrust due to the angularity of the teeth, partially relieves the thrust blocks of the propeller shaft. The wheel V has a hollow rim made up of sprockets of soft iron coarsely laminated; these sprockets have the same angle, width and pitch as the threads of the worm opposite which they move with a clearance of about ¼ inch. This wheel is keyed on the propeller shaft driven by the reciprocating engine at 75 revolutions per minute. To clearly understand how the tangential pull on the rim of the wheel is obtained by means of apparently perpendicular lines of force, it must be pointed out that the latter are not actually normal to the circumference of the wheel, but, owing to difference in the degree of saturation of the iron sprockets due to a slight advance of the worm threads under load, the lines of force cross the air gap at an angle, dragging the wheel in the same way as the armature of an electric motor is pulled back into the field when shifted along its center line.

"The transmission losses are the electrical energy necessary for exciting the magnetic field and the hysteresis and Foucault currents in the iron of the worm and wheel. From experiments I have made, I found that a magnetic density of 15,000 lines per square centimetre is required to give a tangential force of 22 pounds per square inch of iron face. With a total air gap of one centimetre, a number of ampere-turns equal to 800 × 15 = 12,000 is required for producing the necessary magneto-motive force. As there are two parallel magnetic circuits (wound in series) it will really be 24,000 ampere-turns, to which we must add 6,000 ampere-turns to overcome the resistance of the iron circuit, and this brings the total to 30,000 ampere-turns. Let us now assume that the pressure of the electric supply is 120 volts, that the wire with which the coils are wound has a sectional area of .012 square inch, to which corresponds an ohmic resistance of 2 ohms per 1,000 yards, and that we allow a current density of 1,000 amperes per square inch, say, 10 amperes for the section of our wire; then, 3,000 turns of such wire will be necessary to give the 30,000 ampere turns required. The length of each turn of wire being 2 yards, the total length of the electric circuit will be 6,000 yards, whose total resistance (at 2 ohms per 1,000 yards) is 12 ohms. The formula $R \times I = E$, in which R is the resistance of the circuit, I the intensity of the current, and E the electro-motive force, is verified: 12 ohms × 10 amperes = 120 volts. The total electrical energy corresponding to these figures is: 10 amperes × 120 volts = 1,200 watts, which is less than 1 per cent. of the total power transmitted (300 horse power). Owing to the laminated state of the worm, and also the sprockets of the wheel, the loss through eddy currents and hysteresis is very low and always less than 4 per cent. of the total power, which, added to the 1 per cent. of the field excitation, will give a total loss of 5 per cent.

"The total weight of the 300 brake horse-power gear for reducing the speed from 3,000 revolutions to 75 revolutions per minute is 11 tons, of which two tons is for the worm with its shaft and bearings, four tons for the wheel and five tons for the field magnet. Comparing these figures to electrical transformation, it would be in the latter case: One 250 kilowatt dynamo at 3,000 revolutions per minute, three tons (approximately); one 300 horse-power motor at 75 revolutions per minute, 27 tons (approximately); total, 30 tons. The magnetic gear can run in both directions if the turbine is reversible; if such is not the case, the excitation is cut off by means of a switch, and the reciprocating engine gives alone the reverse motion without the assistance of the turbine."

POWER CONSUMPTION OF STEAM AND ELECTRIC HOISTS.

RESULTS OF TRIALS OF GERMAN STEAM AND ELECTRIC HOISTS, SHOWING THE COMPARATIVE POWER CONSUMPTION OF VARIOUS TYPES.

Glückauf.

SOME time ago a committee was appointed by the joint action of the Society of German Engineers, the Association for the Protection of Mining Interests, and the Dortmund Boiler Inspecting Association, for the purpose of carrying out exhaustive experiments on the consumption of power in hoisting engines, with a view to establishing comparative data of the economy of the various types. The experiments were divided into two classes: one series extended continuously over a certain period of time; the second series consisted of isolated measurements. A preliminary report summarizing the data obtained in the first series has been published in *Glückauf* for August 27. The accompanying table, rearranged from a translation of this report printed in the *Colliery Guardian* for September 30, gives the results of the trials of four electric and five steam hoists, all of them serving collieries in the Dortmund district.

With reference to the table, "useful load" is the difference between the raised

STEAM HOISTS.

Colliery	Schürbank and Charlottenburg, Aplerbeck.	Julia, No. 2 shaft, Herne.	Helene and Amalie, Amalie Shaft, Essen-West.	Wilhelmine Viktoria, Shaft 1, Gelsenkirchen.
Data of hoisting plant:				
Type of engine	Twin tandem	Twin tandem	Twin tandem	Two-cylinder
Cylinder diameter, inches	2 by 34/50	2 by 34/50	2 by 28/48	2 by 42
Stroke, inches	78¾	78¾	63	78¾
Type of electric plant	......	......	......	......
Capacity of Ilgner motor, horse power	......	......	......	......
Weight of flywheel, tons	......	......	......	......
Normal capacity of motors, horse power	......	......	......	......
Type of driving pulley	Cylind. drum	Cylind. drum	Koepe pulley	Koepe pulley
Diameter of ditto, inches	315	315	275	256
Weight of cage and fittings, tons	6.59	6.375	6½	4.2
Number of decks per cage	8	4	3	4
Number of cars per cage	8	8(each 2 end on)	6(each 2 end on)	8(each 2 end on)
Useful load per normal trip, tons	5.431	4.205	3.282	4.576
Weight of top rope, pounds per yard	19⅝	21½	19⅝	15
Weight of tail rope, pounds per yard	19⅝	21½	19⅞	15
Number of times rope taken up	3 and 7[a]	3	2	3

Results of trials:								
Length of trial	7 hrs. 55 mins. (main shift)	24 hrs. (main shift)	7½ hrs.	24 hrs.	8 hrs. (main shift)	8 hrs. (main shift)	8 hrs. (main shift)	24 hrs.
Load raised, tons	1,598	1,906	1,724	3,469	1,120	1,226	1,560	1,616
Load lowered, tons	485	627	745	1,569	396	468	583	628
Useful load, tons	1,113	1,279	979	1,900	724	758	977	988
Height of hoist, yards	660	660:656[a]	448	448	602	602	664	664
Number of trips	202	282	260	600	217	240	210	302
Mean velocity, yards per second	12	...	9½	...	10⅜	10⅝	12	...
Mean useful load per trip, tons	5.510	4.535	3.765	3.167	3.336	3.159	4.652	3.272
Mean output of energy, shaft horse power	313.8	119.2	197.9	119.7	185.6	194.4	274.5	92.6
Admission pressure, atmospheres	11.2	10.9	9.2	9.2	7.1	7.2	7.4	7.3
Degree of superheating, degrees C.	218	200	Saturated steam.		Heat accumulator.		Saturated steam.	
Vacuum, per cent	74.0	76.3	Exhaust.				Exhaust.	
Calculated total steam consumption, pounds	89,838	151,470	85,377	195,600	80,696[c]	78,793[c]	102,080	146,837
Steam consumption per shaft horse power, pounds	36.3	53	59	68	44.3[c] & [d]	50.64[c]	46.48	61.16
Working tension of polyphase current, volts	....	....	....	....	....	....	....	....
Total electric energy absorbed, kilowatt-hours	....	....	....	....	....	....	....	....
Consumption of energy per shaft horse-power, kilowatt	....	....	....	....	....	....	....	....

---

[a] Three times during main hoisting shift, seven times during the remaining period. [b] With exhaust-steam turbine attached. The figures for the twenty-four hours' test are of no value for comparison, and have therefore been omitted. [c] The values are rather too favourable, the condensed water in the intermediate receiver and engine being measured, and deducted, with that in the live-steam pipe. [d] The corresponding efficiency of the exhaust-steam turbine could not be determined, the exhaust steam of the hoisting engine being insufficient to keep the turbine in work, so that exhaust steam from other engines had to be drawn upon. The steam consumption of the exhaust-steam turbine was: under full load, 30,443 pounds for 740 kilowatts per hour = 41⅛ pounds per kilowatt-hour; and under half-load, 17,032 pounds for 350 kilowatts per hour = 48.66 pounds per kilowatt-hour.

load and the lowered load. In a "normal trip" the ascending cage is filled with loaded cars, and the descending cage with its full complement of empties. The weights of the full and empty cars are mean figures, determined from a large number of single cars. The "height of hoist" is the depth of the main haulage level. In occasional hoists from other levels the corresponding height of hoist has been included in the calculation. The "calculated steam consumption" is the difference between the weight of the boiler feed water and that of the water of condensation from the steam pipes.

In the course of the investigation, the committee arrived at the conviction that the usual method of testing engines at the time of taking delivery from the makers is unsuitable as a basis for reliable comparative data on the different types of engine, since it does not allow

ELECTRIC HOISTS.

Deutscher Kaiser, Shaft V, Hamborn.		Rheinelbe, Shaft II, Gelsenkirchen.		Mathias Stinnes III./IV., Shaft 3, Brauck.				Emscher-Lippe, Shaft 2, Datteln.	
				Machine No. 1.[b]		Machine No. 2.[b]			
......		......		......		......		......	
......		......		......		......		......	
......		......		......		......		......	
Ilgner		Ilgner		Ilgner		Ilgner		Ilgner	
765		1,000		500		500		1,440	
49		52		40		40		Two of 40	
Two of 510		Two of 750		Two of 550		Two of 550		Two of 950	
Koepe pulley		Koepe pulley		Koepe pulley		Koepe pulley		Koepe pulley	
315		276		255		255		252	
8		6½		8¼		7⅛		5¾	
4		4		4		6		4	
8 (each 2 end on)		8 (each 2 end on)		8 (each 2 end on)		6		8 (each 2 end on)	
4.374		4.554		5.456		4.092		6.352	
21⅛		18⅜		28¼		21		18½	
21⅛		17½		18⅜		18⅜		18¾	
3		3		3		3		3	
8 hrs. 54 min. (main shift)[a]	24 hrs.	7¼ hrs. (main shift)	24 hrs.	8 hrs. (main shift)	24 hrs.	8 hrs. (main shift)	24 hrs.	8 hrs. (main shift)	24 hrs.
1,245	2,285	2,302	4,417	1,297	1,370	558	1,666	2,785	5,566
570	1,020	760	1,725	601	693	236	708	983	2,055
675	1,265	1,442	2,692	696	677	322	958	1,802	3,511
414	414	403	403	585	585	585:420[c]	585:420[e]	733	733
188	365	294	578	157	232	94[c]	305[e]	284	608
8.85	...	9.18	...	8.2	...	8.1[d]	...	12.1	...
3.59	3.466	4.904	3.970	4.431	2,917	3.421	3.140	6.345	5.774
106.2	73.8	262.7	153.4	172	55.9	72.9	76.3	559	363.4
....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....
5,000	5,000	5,000	5,000	Machine	5,000	Machine	5,000	3,000	3,000
2,330	4,777	3,290	7,476	I. and II.	3,850[f]	I. and II.	8,454[f]	6,217[h]	13,571[h]
2.47	2.70	1.67	2.03	in 8 hrs.	1.97[f]	in 8 hrs.	2.66[f]	1.39[h]	1.56[h]

---

[a] In this case, hoisting the men in the morning is included. [b] The two Ilgner units were coupled mechanically. [c] 28 trips from a depth of 420 yards. [d] Wound from a depth of 585 yards. [e] 37 trips from a depth of 420 yards. [f] These figures are rather too unfavourable, since the compressor (consuming about 25 kilowatts, for which no deduction has been made) for the hoisting brake was worked in parallel with the compressed-air main of the pit. [g] As a rule, two coupled Ilgner units, each with a 40-ton flywheel, work both hoists in No. 2 shaft. In the trial the one unit was run with both flywheels. [h] The figures are rather too favourable, the compressed air for the pneumatic brake being drawn from the general compressed-air main, without any addition being made to the figures to allow for this.

properly for the influence of the depth, useful load, and general working conditions, the lowered loads, for instance, being insufficiently taken into consideration. Moreover, and especially in the case of the steam hoists, the manner in which the engineer operates his engine has a determining influence on the consumption. It was these considerations which led to the making of the isolated measurements, which consisted in observing single trips with weighed loads and at different prescribed velocities. These trials are not yet completed, so that it cannot be stated with certainty whether they will furnish the desired new basis of comparison to supersede the present standard, the amount of energy consumed per shaft horse power. We shall hope to present data on this point upon the appearance of the final report of the committee.

THE TESTING OF FILES.

A BRIEF DESCRIPTION OF THE HERBERT FILE-TESTING MACHINE, AND OF AN IMPROVEMENT DESIGNED TO BRING ITS ACTION CLOSER TO PRACTICAL CONDITIONS.

Prof. W. Ripper—British Association for the Advancement of Science.

BEFORE the introduction a few years ago of the file-testing machine invented by Edward G. Herbert, whose machine for testing the durability of tool steels has been referred to in these columns more than once, no method of testing quantitatively the cutting power of files was available. The file purchaser was obligated to rely entirely on the reports of durability furnished by more or less skilled workmen. The Herbert machine sprang into immediate popularity, and many large purchasers of files adopted the practice of specifying a certain standard of durability to be determined by the machine. It was not long, however, before doubt was cast upon the accuracy of the results obtained by this method of testing, because of the glaring anomalies observed in the test records. Files considered to be of the best quality gave poor results in the testing machine; great differences of cutting power were recorded of files supposed to be in all respects alike; and differences in cutting power of as much as 10 to 1 were commonly recorded of the two sides of the same file, even among the best makes. A general demand for an investigation of the accuracy of the results given by the machine led to a series of experiments conducted by Prof. W. Ripper, of Sheffield University, whose description of the Herbert machine and the modifications suggested by him, read at the recent meeting of the British Association for the Advancement of Science and printed in the *Mechanical Engineer* for September 23, is briefly abstracted below.

"The action of the Herbert file-testing machine is briefly as follows: The file to be tested is held rigidly between two headstocks on a reciprocating table. The test bar is supported in a horizontal position on grooved rollers, and is pressed against the file by a weight in the front of the machine, attached by a chain passing on rollers under the bar by a clip to the outer extremity of the bar. By the reciprocating motion of the file acting on the end of the bar a portion of the bar is cut away each stroke, the amount of which depends upon the quality of the cutting power of the file under test. The file cuts on the forward stroke. On the backward stroke, the bar is drawn out of contact with the file by means of an ingenious clutch lever acting after the manner of a spanner. At the beginning of the forward stroke the bar is released from the clutch, and by means of the weight previously mentioned it is pressed against the bar with a pressure of 30 pounds per square inch. Heavy weights suspended from the reciprocating headstock rest against the back of the file in order to prevent chattering and jarring of the file, which would otherwise occur.

"The recording gear attached to the machine consists of a large drum round which is wrapped a diagram sheet of squared paper. The drum rotates very slowly by a reducing gear driven from the crank shaft, and permits of a line being drawn in a direction parallel to the base, and representing the number of strokes made by the file. A movement of the pencil at right angles to this is made to record the amount of material filed away from the end of the test bar. This movement is obtained by a connection between the pencil and the moving bar, the sliding forward of the bar as it becomes shorter giving the motion required to the pencil. By means of the two movements here described a curve is drawn representing the number of inches filed from the bar and the number of strokes made by the file in performing the work recorded. The slope of the curve indicates the rate of cutting, or sharpness of the teeth of the file, and the curve shows clearly how the rate of cutting falls off as the file deteriorates, until, when the file is worn out, the line becomes parallel to the base of the drum."

Prof. Ripper's tests were not long in demonstrating that the machine "differs in its action from hand filing in one important direction, namely, that in the machine the file moves across the face of the test bar through an absolutely constant path, the respective teeth of the file each stroke working in identically the same grooves or furrows on the face of the test bar stroke after stroke. The result is that the face of the work occasionally becomes glazed in appearance, and the file ceases to cut, though the file itself may not be worn out. In the case of hand filing no two strokes are made exactly in the same direction. The conditions, therefore, under which the tests are made in the machine differ from those under which the file is worked in actual practice, and this difference works to the disadvantage of the file.

"With a view to determining the effects of revising the machine so as to make it approach more nearly to the conditions of hand filing, Prof. Ripper has devised an addition to the Herbert machine by means of which the path of the file is no longer a constant one, but slightly changes its direction stroke by stroke, as in the case of hand filing. To secure this, the file is no longer held rigidly at its two ends, but is connected by ball joints, the effect of which is equivalent to that of a wrist movement at each end of the file. The variation of the path of the file is obtained by slightly shifting the position of one end of the file relatively to the other end by a simple mechanism secured to the reciprocating headstock. The change of position is made during each return stroke, so that on the following working stroke the file moves in a different path from that which it had in the preceding stroke.

"The ball joint at the tang end of the file is fixed to the reciprocating head, merely permitting a movement about its own centre. The ball joint at the opposite or outer end of the file is also carried by the reciprocating table. This ball joint travels in a small circular path, 1/16-inch radius, in a plane at right angles to the axis of the file. The small rotating movement of this outer ball joint is obtained by turning the socket out of the disc which holds the ball, so that the socket has 1/16-inch eccentricity relatively to the centre of the disc itself which carries it. On the edge of the disc so constructed, worm wheel teeth are cut, gearing with a worm in such proportion that the worm wheel rotates once for every 48 double strokes of the file, or, in other words, there is a change of position each double stroke of 1/48th of a revolution of the outer ball joint, about the centre of the disc which contains it. The disc and worm gear are carried by the outer reciprocating headstock.

"A further problem was how to convert the reciprocating motion of the table into a rotating motion of the worm wheel in one direction only. This is accomplished by fixing on the axis of the worm a bicycle free wheel with teeth on its outer edge gearing with a chain fixed between two stationary points of attachment. Then when the table reciprocates, the wheel runs free in one direction and grips the worm spindle in the other, resulting in the rotation of the worm always in one continuous direction, the worm rotating during one stroke and remaining free during the opposite stroke."

The use of this apparatus in the large number of tests made by Prof. Ripper almost entirely removed irregularity from the results of tests on files of similar quality. The results show also that the difference in cutting power between the two sides of the same file is not great. The tests were made up to a limit of 40,000 strokes for each test. It is possible that a prolongation of the test until the file entirely ceases to cut might modify the results. In Prof. Ripper's opinion, however, durability tests "should not be carried on till the file entirely ceases to cut, but should be carried rather to where the file would, in ordinary practice, be considered unfit for further use, which condition would be reached when the rate of cutting has fallen to, say, one-fourth of the standard of cutting required for the sharpness tests. It seems desirable also to allow a weight of 30 pounds during the first portion of the test in order to determine cutting power, and then to increase the weight, say to 50 pounds, for the remainder of the test, which might then be considered a separate durability portion of the test. In this way much time would be saved.

"It will be noticed that this mechanism amounts to a movement of the centre line or axis of the file in such a way that the axis describes a cone, which is its apex at one end and its base at the other end, the length of the axis of the cone being equal to the length of the file, and the diameter of its base ⅛-inch. The face of the file is in the two extreme horizontal positions of the ball joint slightly inclined to the face of the work, its plane of motion moving about an axis passing through a guide point.

"It may be contended that the arrangement now proposed is equivalent to adding additional weight to the bar, because alteration in the position of the file relatively to the face of the bar tends to cause the file to bear on a portion only of the area of the face, and not to cover the whole area, and thus the pressure per square inch between file and face is increased. To what extent this is true depends entirely upon the rate at which the change of position of the file takes place. Its change of position can be made to occur so slowly that the file bears over the whole area of the surface every stroke. The rate as at present arranged is one small cycle of movement every 48 double strokes, and this seems a satisfactory rate, because it does not appear from the diagrams that the rate of cutting under these conditions is greater than under the old conditions. The only difference is that with the new method of cutting abnormal results disappear, and the curves obtained for the same make of files, or for the two sides of the same file, are generally remarkably similar and regular in character.

"The feature of the mechanism and the principal point to be secured is a change of direction of motion of the file stroke by stroke instead of a constant repetition of the same path. It is plainly possible to give the file such a motion in one plane only by giving it a slight rocking motion in a vertical plane without any sloping whatever of the face of the file in relation to the work. The objection of the reduced area, and therefore increased pressure per square inch, would then be removed entirely. The present arrangement, however, gives the file an excellent chance to do its best."

SPEED REGULATION OF STEELWORKS MOTORS.

A REVIEW OF RECENT SYSTEMS OF SPEED REGULATION APPLICABLE TO ALTERNATING-CURRENT MOTORS.

J. J. Elink Schuurman—Iron and Steel Institute.

IN the large modern steelworks, alternating current has practically superseded direct current for the various applications of electric driving. Early applications of electric power were on a small scale, to which continuous current was well suited. But with the gradual extension of the electric drive, which in the most modern plants is applied to practically every purpose requiring power, the increasing distance of transmission made continuous-current distribution more and more uneconomical, until finally its use was abandoned except in small installations. It is only recently, however, that a most important disadvantage of the alternating-current system in comparison with the direct-current system has been removed. This is in the matter of motor speed regulation. The continuous-current motor is well adapted to simple and economical speed regulation, but before the invention of the three systems described below, after a paper read by J. J. Elink Schuurman at the recent meeting of the Iron and Steel Institute, the regulation of alternating-current motors could be obtained only by very wasteful methods.

In speed regulation in a definite direction of rotation, a distinction must be made between the adjustment of different no-load speeds with a slight drop of speed between no load and full load, the adjustment of different no-load speeds which drop to a certain adjustable extent between no load and full load, and a regulation which causes a large drop of speed when the load is applied, but does not permit of adjusting at various no-load speeds. Further, it is often required that the output should remain constant at all speeds, although a constant torque over the entire range of speed regulation is generally sufficient.

Which of these different forms of regulation are applicable to the different operations in iron and steel works? For rolling mills it is often necessary to obtain different no-load speeds, depending on the rolling programme. The type of mill will determine whether these speeds should remain constant from no load to full load (wire mills and others where the load remains fairly constant), or whether a drop of speed is required (blooming and similar mills in which considerable peak loads are experienced). An interesting phase of the speed-regulation problem is presented by the high-speed rotary blowers which are gradually replacing reciprocating blowers in blast-furnace plants and steelworks. When the speed is constant, the rotary blower produces a pressure which is practically independent of the volume of air delivered. A change of pressure can be obtained by varying the speed, and as the pressure increases approximately with the square of the velocity, comparatively small alterations in the speed will suffice to produce the necessary pressure variations. When the blower is electrically driven, a high-speed motor must, of course, be used, and except in special cases the motor must be capable of easy and economical speed regulation. The requirements of blast-furnace blowers are comparatively easy to meet. Steelworks blowers, however, are called upon to supply pressures from 5 to 35 pounds per square inch, as well as widely varying volumes of air; the driving motor must be capable of a wide range of speed regulation, preferably of the type in which the speed, once adjusted, does not vary between no load and full load.

The three-phase induction motor, which is most extensively used for electric driving in steelworks, possesses the great advantages of simplicity and safety of operation, but in its original form the speed, which depends upon the number of poles and the frequency of supply, cannot be economically regulated. The simplest means of speed variation, the insertion of an adjustable resistance into the rotor circuit, has often been used for regulating the speed of rolling mills, but is very uneconomical because an amount of energy, proportional to the percentage of the regulation, is lost in the slip resistance. Another disadvantage of this method of regulation is that for an adjusted slip resistance, the speed changes to a very great extent with variations of the load, and rises to practically its normal value at no load. This running back to the synchronous speed can be of great inconvenience in the operation of rolling mills, as it is just when running light that a low speed is required in order that the rolls may get a hold on the steel. The power factor is another characteristic of the induction motor which merits careful consideration. Rolling mills, because of the employment of low-speed motors, the intermittent character of the load, and the construction of the motors, for mechanical reasons, with large air gaps, which involves a large magnetizing current, commonly have a low power factor; the recent systems of speed regulation for induction motors have been designed with the secondary purpose of improving the power factor by compensation of the phase difference.

The first of these systems was invented by Dr. A. Scherbius. Instead of being connected with a variable resistance, the slip rings of the induction motor are connected with a "regulating motor" of the three-phase commutator type, generally shunt excited and so wound that it possesses no inductance, hence for all practical purposes operating as a continuous-current machine. Its purpose is to convert the slip energy, formerly lost in resistance, into mechanical energy. "The speed regulation of the main induction motor is obtained in a simple manner by adjusting the excitation of the commutator motor. As is well known, the slip of an induction motor is proportional to the rotor voltage. When the rotor voltage is forced by exterior means to increase, the speed will have to decrease. For a strong excitation of the regulating motor the speed of the main motor will consequently be low, whereas for weak excitation it will be in the neighborhood of synchronism. As the armature voltage of the regulating motor, which differs from the rotor voltage of the induction motor only to the extent of the ohmic drop in voltage, merely depends upon the excitation, the speed will remain constant from no load to full load. When a drop of speed is required between no load and full load, the regulating motor is provided with a compound exciting winding. As in the case of a continuous-current compound motor, the speed will then drop from no load to full load over a certain adjustable range. Finally, a series excitation can be provided, which entails a form of regulation similar to that by resistance."

The slip energy converted into mechanical energy by the regulating motor may be recovered in either of two ways: the energy may be given back to the main driving shaft by coupling the regulating motor mechanically with the main motor, usually the better arrangement; or the energy may be returned to the line by using the regulating motor to drive a small induction generator. In the first case the available energy in the main shaft remains constant—that is, the torque can be increased as the speed decreases; in the second case only a constant torque is available, so that the output must decrease with decreasing speed. In addition, the total efficiency of the first arrangement is superior to that of the second. It is not always possible, however, to employ the mechanical connection; in some cases the regulating motor, which with mechanical connection must follow the speed fluctuations of the main motor, becomes too expensive for very wide ranges of regulation.

A great advantage of the Scherbius system lies in the possibility of extending the regulation above synchronous speed; hence, the regulating motor can be built smaller than is possible with regulation solely under synchronism. In order to obtain over-synchronous speeds it is only necessary to reverse the direction of the excitation of the regulating motor. The latter then runs no longer as a motor but as a generator. The Scherbius system also permits of compensating the phase difference between current and voltage of the main motor, so that its power factor becomes unity, independently of the load. By a small change in design, the regulating motor can be made to supply the magnetizing current necessary for the excitation of the main motor, thus relieving the generators and the transmission line of the delivery of this wattless current. If necessary the regulating motor can also be designed to supply the excitation for other motors on the line, and thus will contribute still further to raise the power factor of the entire system. The Scherbius system may be applied either in new installations or to induction motors already installed.

A second system of economical induction-motor speed regulation is due to C. Krämer. "The slip rings of the main motor are connected to a rotary converter which changes the slip energy into continuous current. The latter is used to feed a continuous-current shunt motor, which is coupled mechanically to the induction motor and returns the slip energy to the main driving shaft. The speed is regulated by varying the resistance in the shunt field of the auxiliary motor. When resistance is cut out, the armature voltage, and the continuous-current voltage of the rotary converter, will increase. At the same time the alternating-current voltage at the slip rings must increase, as the continuous-current and alternating-current voltage of a rotary converter stand in a fixed relation to each other. The speed of the main motor will thus decrease."

The speed of the rotary converter depends upon the rotor frequency of the main motor, and is proportional to the regulation. As the voltage at the slip rings should also increase in proportion to the regulation, and as in general voltage and speed are proportional values, the design of the rotary converter is practically independent of the amount of speed reduction required. For this reason the Krämer system is very suitable for wide ranges of regulation. The available output remains constant over the entire range of regulation, as the slip energy is returned to the main driving shaft; the power factor of the main motor may be improved to unity by adjusting the excitation of the rotary converter accordingly. The disadvantages of the Krämer system in comparison with the Scherbius system are its greater complication and the greater difficulty of applying it to existing installations.

For small outputs the single-phase commutator motor of the Déri type offers a third solution of the problem of economical speed regulation. This motor belongs to the repulsion-motor class. For each pair of poles the motor has four brush holders, two fixed and two movable, each set of fixed brushes being connected electrically with a set of movable brushes. At rest, both are in line on the commutator in the pole middle. When the movable brushes are shifted to the right, the motor turns to the left, and *vice versa;* hence, a reversal is possible without any switching over. The farther the movable brushes are shifted from the zero position, the more the torque increases. Normally the motor can start with two to two and one-half times the normal torque, and it may be designed for still higher starting torques. It also possesses a large overload capacity.

The great advantage of the Déri motor lies in its extreme simplicity; the entire regulation—starting, reversing, and adjusting of all speeds from zero to 10 per cent. above synchronism—is effected by merely shifting the brushes, and the only extra piece of apparatus required is a two-pole stator switch. When the output is small, the single-phase Déri motor will hardly affect the even distribution of the load on the three phases of the system, especially if there are several motors which can be divided among the different phases. For large outputs it is better to use a double commutator motor, which consists electrically of two Déri motors mechanically built into one. By a simple method of winding, the double motor can be directly connected to a three-phase line, and exact measurements have proved that with it the load is quite as equally distributed over the different phases as in the case of a normal induction motor, while the double motor retains all the good qualities of the simple Déri motor.

For the regulation of rolling-mill motors, both the Scherbius and the Krämer systems are in use. The Déri double motor gives excellent service in driving plate-bending machines, corrugated tube mills, and other small rolling mills of special type. For blowers the Scherbius system with regulating set is often very useful. Most of the auxiliary drives in steelworks, which require speed regulation, are well served by the single or double Déri motor, which is particularly adapted to the operation of live rollers, blast-furnace hoists, travelling cranes, and similar equipment.

THE RECONSTRUCTION OF THE QUEBEC BRIDGE.

A BRIEF DESCRIPTION OF THE METHODS OF REMOVING THE WRECK AND OF THE PLANS FOR THE NEW STRUCTURE.

Engineering Record.

PLANS for the reconstruction of the Quebec Bridge on the site of the ill-fated structure which collapsed during construction a little over three years ago have been completed, and work on the substructure is now in progress, while the contract for the fabrication and erection of the steel work is expected to be awarded very soon. As is well known, the rebuilding of the bridge was assumed by the Department of Railways and Canals of Canada, and a Board of Engineers, consisting of H. E. Vautelet, Maurice Fitzmaurice, and Ralph Modjeski, were appointed to supervise the design and construction. Publicity has not yet been given to the Board's detailed plans and specifications, but data of the general nature of the design, of the methods of removing the wrecked superstructure, and of the construction work now in progress are given in the *Engineering Record* of recent dates.

It will be remembered that the site of the bridge is about 8 miles above Quebec, where the St. Lawrence flows between steep sandstone banks about 3,500 feet apart and 200 feet above low water. The current at this point is very swift and the tide rises 12 to 16 feet. The channel is about 1,200 feet wide at low tide and 2,000 feet at high tide, the depth increasing rapidly from low-water mark to 200 feet in mid-channel. To avoid the very deep water, the main piers of the original structure were located 1,800 feet apart on centers, their sites being in very shallow water at low tide, while the anchor piers were built on dry land. The superstructure was proportioned for a live load consisting of two E-33 locomotives and a train weighing 3,300 pounds per linear foot on each of the two tracks; for 60-ton electric cars on each of the two tracks; for two highways; and for two cantilever sidewalks. The material, carbon steel, was subjected in some members to high unit stresses.

"The superstructure, 2,800 feet long between anchorages, was symmetrical about the center and composed of a 675-foot center span suspended from two 562½-foot cantilever arms continuous across the river piers with the two 500-foot anchor arms. The pin-connected trusses were in vertical planes 67 feet apart, and were 315 feet deep at the main pier and 130 feet deep at the center. Both top and bottom chords were parabolic curves and the panels were 50 feet long in the anchor arm and 56¼ feet long in the cantilever arms. The bottom chords had a rectangular section about 4½ feet deep and 5½ feet wide, made with four built channel webs connected by single angle lattice bars and tie plates on the top and bottom flanges and field spliced with rivetted cover plates. The maximum compression chord pieces were about 68 feet long, with a sectional area of 842 square feet and a weight of 100 tons. The total estimated weight of the superstructure was about 80,000,000 pounds. All pieces were wholly fabricated in the shop and shipped complete to the site." This was the structure which collapsed without warning on the morning of August 29, 1907, following the failure of the lower chord members in the south anchor arm.

The removal of the twisted mass of wreckage was begun in December of last year. The contract called for the removal of about 9,000 tons of material in the anchor arm and in the cantilever arm immediately adjacent to the main pier, the greater part of the cantilever arm lying in very deep water. The pile of wreckage was about 500 feet long, 70 to 80 feet wide, and 10 to 40 feet high. Considerably over half the material has been removed to date by the use of the oxy-acetylene torch and dynamite. A very interesting description of the methods employed is published in the *Engineering Record* for September 17. The use of dynamite is considered more economical than the torch; it is, however, more dangerous and cannot be used in all cases. The method of application is to attach a continuous row of sticks of 65 per cent. dynamite to the member on the line on which it is desired to cut and to explode the charge by means of a battery. It is found that about 1 pound of dynamite per 1,000 pounds of steel is required to break the members into 10-ton pieces within the capacity of the derricks. The rivets are removed by hand in the storage yard.

Turning now to the plans for the new structure, which are described in the *Engineering Record* for September 10, the new bridge, like the old one, "will carry two railroad tracks, two trolley tracks, two highways and two sidewalks on a single deck at about the same grade, but it is proportioned for heavier live loads and smaller unit stresses, thus effecting a large increase in the dead weight of the superstructure.

"Greater stability has been secured by increasing the width between trusses, which necessitates piers longer than those of the former design. Although the old piers were high-class structures, in perfect condition and uninjured by the disaster, it was not considered practicable to enlarge them to receive the new superstructure and it was determined to move the bridge axis 15 feet up stream and to build the north river pier alongside the old pier and clear of it, and to build the south river pier partly on the foundation of the old river pier, removing the old pier masonry in both cases down below low water level, and diminishing the length of the channel span 52 feet. The anchor piers are to be removed and new anchor piers, necessary in order to develop the required larger anchorage reaction, are to be built.

"The new superstructure has short deck approach spans at each end and three main spans, with pin-connected trusses symmetrical about the center line. The channel span is 1,758 feet long on pier centers, with a maximum clearance of 159.3 feet above ordinary high tide in the center of the channel. The regular official design is for a superstructure 3,232 feet long over all with three short approach spans and three main spans 2,930 feet long between anchorages. The main spans have pin-connected nickel-steel through trusses 88 feet apart on centers, symmetrical about the center line, forming one 586-foot suspended center span, about 114 feet deep over all, two anchor arms, and two cantilever arms each 586 feet long and about 298 feet deep over the main piers and is adapted for cantilever erection of the suspended span.

"The most conspicuous features in which this design differs from that of the wrecked structure are the greater width of the structure, the straight line top and bottom chords, the system of web members, the uniform panel lengths, the greater lengths of the anchor arms and the shorter lengths of the suspended span in proportion to the distance between river piers, the heavier loads, smaller unit stresses, rock foundations and various structural details.

"The 8 by 10-foot rectangular bottom chord has a maximum sectional area of 2,037 square inches and is made with four vertical webs connected by top and bottom flange and intermediate lattice bars, by solid flange cover plates between the inside webs and by vertical transverse diaphragms. The depth is tapered from 8 feet at the main pier to 5 feet at the extremities of the anchor and cantilever arms. The top chord is made with two parallel tiers of eye-bars, one above the other. The floor beams have solid double webs 10 feet deep and riveted connections to facilitate erection. The trusses take bearing on the main piers with riveted pedestals 19 feet high which weigh 500 tons each. The heaviest bottom chord pieces weigh 160 tons each and have center longitudinal field splices. The main posts over the river piers weigh 900 tons each. The estimated weight of the entire superstructure is about 145,000,000 pounds.

"An alternative design has been prepared to permit the erection of the center span by floating to position and hoisting from the ends of the cantilever arms. This feature greatly reduces the erection stresses, diminishes by one year the time necessary for construction, and reduces the amount of steel required in the cantilever arms, thus effecting a corresponding decrease in the weight and stresses of the anchor arms and permitting their length to be economically reduced to 502 feet, corresponding with a total estimated weight of about 130,000,000 pounds for the superstructure between anchorages, and involving longer approaches.

"Nickel-steel eye-bars and bottom chord pieces have been tested to destruction to show the comparative efficiency of different methods of annealing and the ultimate strength of the compression members. The bottom chord pieces, made to ¼ scale, developed an ultimate unit strength of about 64,000 pounds and uniformly failed at the transverse diaphragms, all of the principal materials indicating substantially simultaneous failure by compression. When the webs were made with two plates spliced on a longitudinal line to avoid the difficulties of securing plates 96 inches wide for the full size chords, it was found that the strength was very greatly impaired.

"A comparison of the engineers' design with that of the double track, 1,710 feet span of the Forth Bridge shows for the Quebec Bridge: live load per linear foot, 13,340 pounds; total weight, 145,000,000 pounds; weight per linear foot of cantilever only, 49,150 pounds; weight of steel in structure for each pound of live load carried, 3.69 pounds. The corresponding values for the Forth Bridge are, respectively, 4,480 pounds, 114,000,000 pounds, 21,360 pounds, 4.77 pounds. The Quebec Bridge is designed for a load 2.98 times as great as the Forth Bridge, weight 2.3 times as much per linear foot, and is required to sustain a test load 4.33 times as heavy. The new Quebec Bridge is proportioned for a load about twice as great as that for the old Quebec Bridge but its bottom chords have an ultimate strength more than five times as strong, both values being computed from the results of experiments on test pieces."

THE HEAT TREATMENT OF BRASS.

AN INVESTIGATION OF THE EFFECT OF HEAT TREATMENT ON 70:30 BRASS, AND OF THE PHENOMENA OF BURNING.

G. D. Bengough and O. F. Hudson—Institute of Metals.

SOME valuable information on the effects of heat treatment on rolled and drawn 70:30 brass of varying sizes of section and somewhat varying character is contained in the record of a careful experimental investigation by G. D. Bengough and O. F. Hudson, whose paper read at the recent meeting of the Institute of Meals is printed in *Engineering* for September 23. The main object of the research was to throw some light on the phenomena of "burning." The definition of burnt brass given in the paper—brass of which the ductility, as measured by the percentage elongation, has been lowered by heat treatment—was slightly modified by Mr. Bengough in the discussion; he defined it finally as brass unusually susceptible to cracking, in which the susceptibility might be induced by annealing at a very high temperature, or by annealing at a lower, combined with simultaneous mechanical work. The "burning" of brass is a subject on which a good deal of research has been expended, but hitherto without very definite results. While the results of the present investigation are, in the main, negative, they serve to clear up some points of dispute, and place the discussion of others on a more scientific basis.

The experiments were made on test pieces cut from ¾-inch round bars representing the ordinary 70:30 brass of commerce. Three samples were used, of which the first and second (designated G and HB) were hard rolled, and the third (designated B) was in a softer state. The bars had the following percentage compositions:.

Bar.	Cu.	Sn.	Pb.	Fe.
G	71.0	0.02	0.25	0.20
HB	69.4	trace	0.005	0.15
B	69.7	"	trace	0.20

It will be noted that bar HB was of unusual purity. "The bars as received from the makers were cut into 9-inch lengths, turned to a diameter of ½-inch for 4 inches in the centre of the bar, and heated in electrically heated tube furnaces, the temperatures of which were ascertained and controlled by thermo-electric pyrometers. After annealing, the bars were withdrawn at a dull red heat, cooled in air and tested in the ordinary way. Before testing, a piece was cut from each test bar for miscroscopic examination. With a view to ascertaining the influence of size of section, a hard-drawn wire of ⅛-inch diameter was annealed at the same time as the test bars. Test pieces of this bar were also heated in an electric resistance furnace to temperatures between 300 and 600 degrees C., and tested while at these temperatures. Various subsidiary sets of experiments were also made, particularly on the question of 'burnt brass'."

The results of these tests are given in a series of curves and tables. In all the tensile tests on bars and wire annealed for half an hour, "the maximum stress increases with rise in annealing temperature up to about 300 degrees C. It then falls off rapidly to 500 degrees C. The HB bar evidently had received more work than the G bar or the wire, and in consequence there is a much greater numerical loss of strength between these temperatures. Nevertheless, for temperatures between 500 degrees and 800 degrees C., the strength of the HB test bars is in all cases superior to that of the G bars, though the superiority gradually diminishes as the temperature rises, and has disappeared at 850 degrees C. As regards the wire, the strength falls off uniformly from 500 degrees to 900 degrees C., and is, for all temperatures, less than that even of the G bars, the difference increasing as the temperature rises. It will be seen later that prolonging the time of annealing has the effect of lowering the strength of a bar; it would also seem from the above that decreasing the section has a similar effect. The corollary at first sight would seem to be to proportion the time of annealing to the section of the bar, and so to avoid burning thick sections by annealing at higher temperatures. It will be seen later, however, that time is at least as important a factor in burning as temperature. It does not seem, therefore, that any decided advantage can be claimed for the method suggested over the rival one of proportioning the temperature to the section. As a matter of fact, both plans are used in works.

Except in a very few cases, the yield points—the stresses required to give the first noticeable elongation—are not very sharply defined. The most interesting point established with regard to the effect of annealing temperatures on the yield point is the fact that annealing for one hour at a temperature of about 100 degrees C. has no effect on the yield point. Experiments to determine the effects of a period of rest and of very low annealing temperatures on the elastic limit demonstrated (1) that a prolonged period of rest raises the yield point; (2) that annealing for one hour at 90 degrees C. has no effect whatever; and (3) that annealing for one hour at 210 degrees C. very considerably lowers both elastic limit and yield point.

"In all cases the elongation is not much affected until an annealing temperature of 300 degrees C. is passed. Just above this temperature a very rapid increase occurs in the case of the wires. In the case of the bars the rapid increase sets in at about 350 degrees to 400 degrees C. Here, again, an increase in size of section seems to require a longer time of annealing to produce similar results. The maximum elongation is reached with an annealing temperature of 750 degrees C. for the wires, and with approximately the same temperature for the bars G. In both these cases a diminution seems to occur with annealing temperatures above 800 degrees C. For the HB bars, on the other hand, the elongation appears to increase regularly up to a temperature of 900 degrees C. In a general way the variations in contraction of area follow those in elongation. It may be remarked, however, that burning appears to manifest itself first by a falling off in the contraction of area."

The results summarized above were obtained in the tests on bars annealed for only half an hour. Further experiments were made to determine the effects of varying the annealing period; test bars were subjected to temperatures of from 750 to 900 degrees C. for periods of from 6 days to one week. The results show that the time of annealing has an even more important effect on the mechanical properties of brass than the temperature. A temperature but a few degrees below the solidus, if maintained for only half an hour, will not seriously burn a bar of pure brass. A temperature nearly 100 degrees lower will burn the brass if it is maintained for a sufficiently long time. Even small quantities of impurities have an important effect in increasing the tendency to burn.

To investigate the possibility that the presence of reducing gases in the annealing furnace might affect the mechanical properties of the brass, by causing a reduction of small amounts of oxide or slag contained in the metal, a number of bars were annealed in an atmosphere of coal gas. The results, which were practically the same as those obtained with an oxidizing atmosphere, show that the presence of reducing gases is, at any rate, not a predominant factor in the production of burnt brass. A theory of "burning" which has obtained some credence is that the effect is produced by loss of zinc by volitalization. This theory has been tested by estimating the copper in turnings taken at various depths from bars annealed at the higher temperatures. The loss of zinc is appreciable, but it is confined to a very short distance from the surface. Moreover, the zinc does not appear to be removed by violent ebullition, but by gentle diffusion and evaporation from the surface. It seems probable that the removal of zinc is not a primary cause, but merely an accompaniment, of burning. To a very limited extent it occurs also at ordinary annealing temperatures.

Tests were made on the mechanical properties of brass wire at high temperatures. It was found that the maximum stress falls off continuously. The elongation and contraction of area, on the other hand, falls off to very low values at temperatures between 300 and 400 degrees C., after which a recovery of ductility occurs (between 450 and 475 degrees C.) which is practically maintained at 590 degrees C., the highest temperature employed. At the temperature of the ordinary annealing furnace (about 650 degrees C.) the mechanical properties of brass are, as is well known, such as to require rather careful handling. If the temperature of the annealing furnace were to rise somewhat higher than that usually employed, it is possible that the maximum stress might fall off to such a low figure as to be a source of serious difficulty whenever it becomes necessary to handle the alloy. It seems possible, too, that any handling of the material at even a slightly higher temperature than usual, though it may not actually fracture it, may cause a permanent deterioration of its properties.

STERILIZATION OF WATER BY ULTRA-VIOLET RAYS.

THE APPLICATION OF THE QUARTZ-TUBE, MERCURY-ARC LAMP TO THE STERILIZATION OF WATER ON A COMMERCIAL SCALE.

Max von Recklinghausen—Electrical Review; K. C. Grant—Engineering News.

DURING the last few months a vast amount of research work has been carried out in France on the bactericidal effect of ultra-violet rays and their application to the sterilization of liquids. Since the sterilizing action of ultra-violet rays was positively announced by Downes and Blunt in 1877, and particularly since Finsen's classical researches, the use of these rays in therapeutics has shown a steady increase. Further, it is now common knowledge that the ultra-violet rays of the sun play a most important part in the disinfection of water exposed to the sunlight, and are almost wholly responsible for the counteraction of bacterial pollution of rivers, such as is caused by the sewage of large cities, within a few miles of the source of pollution. The experiments now in progress, however, represent the first attempt to utilize the bactericidal properties of ultra-violet rays on any considerable scale.

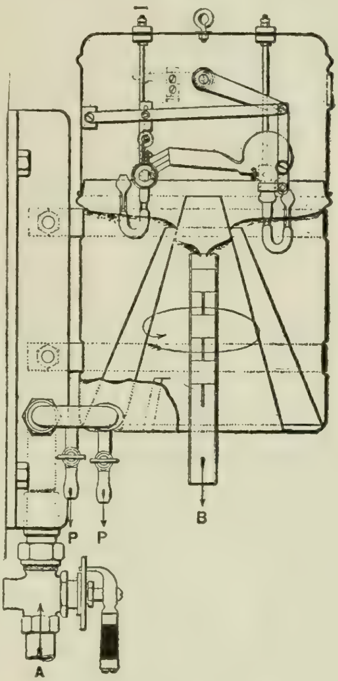
The reason for the long period of neglect of this sterilizing medium is to be found in the lack of a satisfactory light source previous to the invention of the quartz-tube, mercury-arc lamp. The amount of ultra-violet rays which reach the earth from the sun is very small, and some artificial source has to be employed. The development of artificial sources for the production of ultra-violet rays is sketched briefly by Max von Recklinghausen in *The Electrical Review,* for September 2. The well known carbon-bisulphide lamp was the first reliable source. Later, Finsen and his collaborators worked out the arc and spark lamp with metal electrodes. The next lamp to produce a large quantity of ultra-violet rays was the Cooper Hewitt mercury arc, but in the lamp sold for general illumination, the ultra-violet light is not apparent on account of the absorbent properties of the glass used. A large proportion of the ultra-violet rays are transmitted by the "Uviol" glass of Schott and Genossen; the glass *par excellence* for ultra-violet light sources, however, is that produced from molten quartz, and the modern quartz-tube, mercury-arc lamp, although its important application to sterilization was for a time unrecognized, is the basis of all modern research.

The most important of the investigations to which reference has been made is that in progress at the physiological laboratory of the Sorbonne in Paris, a brief description of which is contributed by Kenneth C. Grant to *Engineering News* for September 15. The object of the Sorbonne experiments is to perfect a practical application of the sterilizing action of ultra-violet rays to the purification of polluted water for public water supplies. The process used consists, in brief, in exposing the water to the ultra-violet rays from a quartz-tube, mercury-arc lamp suspended above and close to the surface of the liquid; the micro-organisms therein are killed by the direct action of the ultra-violet rays, without the evaporation of the dissolved gases, the precipitation of the soluble salts, or the formation of ozone or oxygenated water, either of which might alter the taste and composition.

The experiments are made with very simple apparatus. A tank is filled with water from the Paris supply, which is then innoculated with about 5,000 bacteria per cubic centimetre. The water, raised from the tank by a small electric pump, is metered into a serpentine trough, through which it flows and from which it is metered back into the tank. The water passes under four lamps placed over the tortuous part of the trough, the rate of flow being regulated by the speed of the pump. Mr. Grant gives some data of the results obtained. A diagram based on the study of samples taken when the water was flowing at the rate of 1,270 cubic feet per hour, with two lamps in use, shows that after passing the first lamp the bacteria were reduced to about 3,800 per cubic centimetre, and were entirely destroyed by the second lamp. Each of the lamps required 660 watts per hour; hence the sterilization was at the rate of 960 cubic feet per kilowatt hour. With electricity at one cent per kilowatt-hour, therefore, the cost of energy is about $1.40 per 1,000,000 gallons.

"These experiments have successfully demonstrated the commercial possibility of purifying water in large quantities by this process. They are being continued in the attempt to increase the efficiency; this is being done by passing the water through a specially constructed chamber or valve in the trough, by means of which it is three times exposed to the rays of the same lamp. The clearness of the water used is an important factor in obtaining high efficiency. A turbid water, offering resistance to the passage of the ultra-violet rays must pass the light with a less depth and a lower velocity. In any installation for a large supply, therefore, it will be necessary in many cases to include in the scheme a suitable type of filter for prefiltration purposes, at times when the water is turbid.

"The first attempt to put this method of purification into practice is at Marseilles, France, where an experimental plant is being operated in competition with several other types of filtration and purification work." The capacity of this plant is reported to be 3,500 cubic feet per hour, sufficient for a town of about 10,000 inhabitants. The apparatus used is similar in principle to the small sterilizer for hospital use, a diagram of which is taken from Max von Recklinghausen's paper in *The Electrical Review.* In this apparatus 132 gallons of sterilized water per hour is produced from ordinary city water by means of one Cooper Hewitt "Silica" lamp, consuming 3 amperes at 110 volts. The inlet pipe is fitted with an adjustible valve of a special pattern, to enable the apparatus to deal with the various water pressures met with in different districts. "The water enters the chamber formed by the outer cone with a swirling motion. At the top of this cone it overflows and finds an outlet at the bottom of the inner cone, up which it rises and flows out of the discharge pipe at B. The swirling motion is maintained during the complete passage of the water through the apparatus, in order that it may be thoroughly stirred up and all microbes presented to the action of the light, the water coming under its influence on two distinct occasions. Drain



SECTION OF STERILIZER.

cocks P are provided on the apparatus, to enable it to be thoroughly drained, should circumstances arise whereby it would not be used for a considerable time."

The lamp used in the Sorbonne experiments is of the same curious shape as that shown in the diagram. The U-tube at each end has a platinum seal at the contracted portions, and the portion between the seal and the end of the U-tube is filled with mercury, to insure absolute air-tightness of the seal. Above the seals sufficient mercury is contained to fill both ends just to the level of the bottom of the inclined portion of the tube. To light the lamp, the current is switched on and the tube is raised slightly at the positive or bulb end by means of a starting handle and suitable connecting levers. The mercury in the bulb runs down to the other end and a short circuit is made. When the tube is thrown back into its original position, the mercury stream is broken, an arc is sprung, and the tube becomes highly luminous.

PYRITE SMELTING AND SULPHURIC ACID MANUFACTURE.

AN EXAMINATION OF THE TECHNICAL AND ECONOMIC FACTORS IN THE RECOVERY OF SULPHURIC ACID AS A BY-PRODUCT IN COPPER SMELTING.

F. J. Falding and J. Parke Channing—Engineering and Mining Journal.

ON two previous occasions within the last two years* we have referred in these columns to the recovery of sulphuric acid as a by-product in copper smelting. Both reviews were descriptive of the methods employed by the two principal copper companies operating in Tennessee. We return to the subject to present, in abstract, a very lucid exposition of the technical and economic factors involved in the problem of pyrite smelting for acid recovery, contributed by F. J. Falding and J. Parke Channing to the *Engineering and Mining Journal* for September 17.

Pyrite smelting is a method of matte-smelting sulphide ores having iron as a base, which involves the utilization as completely as practicable, as fuel for the smelting process, of that part of the sulphur contained in the ore which is driven off as a gas in the preliminary operations of roasting or desulphurizing, as practised in ordinary blast-furnace smelting. Only sufficient coke is added to the blast-furnace charge to supply the heat for the smelting process which the natural fuel in the ore is unable to supply.

"In pyrite smelting, whether with or without coke, the constitution of the gases produced (apart from irregularities in the functioning of the furnace) will depend in the first place entirely upon the air admitted at the tuyeres. If only sufficient air is admitted at the tuyeres to provide oxygen for the oxidizing functions of the furnace, including such constituents of the charge as after oxidation pass out as furnace gases, then, if no coke is used, these exit gases will consist entirely of sulphur dioxide and nitrogen (together with flue dust and fume); or if coke is used, then the gases will consist of sulphur dioxide, carbon dioxide and nitrogen. In neither case would the resulting gases be suitable for making sulphuric acid, as there would be no oxygen for the conversion of the sulphur dioxide to the trioxide (SO_2 to SO_3) nor would there be the technically necessary excess of oxygen.

"If any excess of air is admitted at the tuyeres, there will be a corresponding excess of free oxygen in the resulting gas, whether smelting with or without coke. This excess can be so regulated that the resultant gases will have the proper composition as well as sufficient free oxygen for sulphuric-acid purposes, provided: (1) that the carbon or coke in the charge is not in such excess that to admit sufficient air to provide the necessary free oxygen for the sulphuric-acid process, would dilute the resulting gas below 4 to 5 per cent. SO_2, or below a practical strength for making sulphuric acid; and (2) that such admission of extra air at the tuyeres would not interfere with the smelting operation. If such admission of air in excess at the tuyeres would interfere with the smelting process, then in both cases (with or without coke) additional oxygen would have to be added to the gas at some place between the top of the furnace burden (or the issuing point of the gas from the charge) and the apparatus where the further oxidation takes place; or the excess of air may be admitted into the apparatus itself.

---

* THE ENGINEERING MAGAZINE, February, 1909, and July, 1910.

"If it were possible to maintain an exact and constant equilibrium between the oxygen supplied at the tuyeres and the oxidizable contents of the charge, then a gas of uniform composition would result. For many reasons this is technically an impossibility, and consequently the gas issuing from the furnace is irregular and fluctuating. Sometimes the free oxygen is excessive, sometimes it is normal, and more often it is deficient or entirely wanting (as evidenced by the volatilization of sulphur and presence of CO).

"If the necessary quantity of oxygen were to be supplied at the tuyeres, then the volume admitted would have to be mechanically regulated in conformity with the analysis of the issuing gas. With the volume and pressure of the air remaining constant, the issuing gas must necessarily fluctuate as long as the charging of the furnaces is intermittent, for the furnace burden just after charging will contain more sulphur, iron and coke than it does just before charging.

"If the regulation of the supply of oxygen is to be provided above the charge, this can be accomplished, either by increasing the draft which is used to carry away the gas and thus induce the admission of air through openings provided in the top of the furnace; or the contrary, by decreasing the draft to reduce the admission of air through these openings; or otherwise by taking all precautions against the admission of false air by providing air-tight furnace tops so that the gas will not be diluted and the draft remain constant, when any deficency of oxygen can be supplied by mechanical contrivances such as fans, blowing engines, etc., which can deliver a controlled volume of air.

"If the furnace be provided with a second set of tuyeres above the smelting zone, the necessary excess of air might be provided without interfering with the smelting zone and in such a way as to secure the complete combustion of the sulphur which is partly driven off in the upper part of the furnace burden, and also to prevent the formation of crusts and bridges in the burden and probably also the more rapid formation of a higher-grade matte.

"More careful attention to the method of charging the furnace in pyrite smelting will produce better metallurgical results as well as a more constant gas. Such considerations would be: (1) an approximate sizing of the constituents of the charge; (2) the more thorough admixture of the charge; (3) the greater regularity in the distribution of the charge, and in the time of charging, smaller and more frequent changes being used—or some method of continuous charging.

"From the above it is evident that to make the gas from pyrite smelting suitable for sulphuric-acid purposes two points are vital: (1) that there shall be no coke in excess of a percentage on the sulphur content of the charge, which maximum percentage can be calculated for any given charge, and (2) that the furnace from the tuyeres up to the point where the gases are taken to the acid plant, must be so designed that a controlled quantity of air in excess of that required for the matte-smelting process can be admitted (a) at the tuyeres, or (b) between the tuyeres and the top of the furnace burden, or (c) between the top of the furnace burden and such points in the acid plant up to where the sulphur dioxide is completely oxidized, or (d) in part at any of these points. All admission of false air must be prevented as far as possible."

To illustrate the calorific power of iron and sulphur, the authors give four numerical examples of the calculation of the coke required for smelting pyrite or pyrrhotite ore charges containing various percentages of iron and sulphur. These data are used later to illustrate the method of calculating the quantity of air required and the composition of the resulting gas in each case. A chart shows for furnace charges containing 20, 30 and 40 per cent. of iron the relation between the sulphur content, above that required for matte, and the percentage of coke required for the smelting process and the percentage of SO_2 in the gas.

So far the discussion has considered the use of only one furnace. It is doubtful whether the gas from a single furnace can be used economically for the production of sulphuric acid. By observing the precautions mentioned above and by exercising great care in the management of the furnace, a reasonably uniform gas can be produced; a shut-down of the furnace for any reason, however, causes an undesirable interruption in the operation of the acid plant. The case is different when there are a plurality of furnaces. "In this case the furnaces must be provided with gas outlets discharging both into the main flue from which gas is taken to the sulphuric-acid plant and also into a by-pass flue connecting with the stack or discharge into the air. Both these exits must be provided with well fitting valves or dampers easily operated. Then it will be possible to cut out any furnace which is dead or for any other reason is not producing a suitable gas, and connect it direct to the stack. The other furnaces, discharging into a common flue, dust chamber or other reservoir from which gas is taken to the acid plant, will then produce an average gas which is much more likely to remain constant in its composition than the gas from any single furnace."

The principal requirement in sulphur-acid making is a constant supply of gas of uniform composition. When the sulphur dioxide and oxygen contents of the gas fluctuate unduly, the regulation of the reagents with which it has to be met in the acid plant—nitrous oxide and water vapor—becomes exceedingly difficult. The fundamental requisites for successful by-product acid making are: (1) furnaces and appurtenances carefully built or remodeled for the production of a suitable and regular gas; (2) reasonable care in operation as to charge, blast at the tuyeres, and draft; and (3) a completely harmonious understanding of the required conditions between smelter manager and acid-plant manager. The utilization of the gas from pyrite smelting in the manufacture of sulphuric acid, after the necessary changes have been made to the plant, involves nothing but reasonable care on the part of the smelter manager.

It is a mistake to assume that since, in pyrite smelting, the sulphur, which is the principal item of cost in sulphuric-acid making, costs nothing, large quantities of acid can be made and profitably transported to any distance. The cost of changes to the smelter plant and the additional cost of manufacture entailed by the fluctuations in composition of the gas must be taken into consideration as additional process costs to the disadvantage of the by-product plant and in favor of the regular chemical manufacturer. In many cases the regular manufacturer receives about 70 cents per ton of 60 degrees B. acid from the sale of pyrite clinker as an iron ore. The cost of Spanish pyrites at central inland points in the United States, according to whether the clinker is sold or not, may be said to vary between $3 and $4 per ton of 60 degrees B. acid at inland cities. Some of these cities secure some of their pyrites locally. St. Louis has local pyrites mines, and Chicago draws a certain amount of her supply from the marcasite which occurs in the Wisconsin zinc ores. In fact, the by-product gases from the zinc smelters will always control the acid production of the Middle West. It is evident, therefore, that the profitable exploitation of the by-product gases at any given smelter will be limited: (1) by a freight rate to point of consumption of from below $3 minimum to $4 maximum per ton of 60 degrees B. acid; and (2) by the sale of such by-product acid in a territory which cannot be entered more profitably by any other smelter manufacturing sulphuric acid. It is a curious fact that while zinc ores are profitably brought east from Colorado for smelting and the production of by-product acid, a smelter in Colorado could hardly compete as an acid maker with a smelter in Illinois, because of the difference between the freight rates on ore and acid, and the necessity of shipping acid in tank cars, which have to be returned empty, and the maintenance and amortization of which must be charged against the acid.

THE ENGINEERING INDEX

"THE KEYSTONE IN THE ARCH OF APPLIED SCIENCE."

The following pages form a *descriptive* index to the leading and special articles of permanent value published currently in the Transactions of all the important engineering societies of both Europe and America, and in all the leading engineering journals of the world—in the English, French, German, Dutch, Italian, and Spanish languages.

The term *descriptive* is used because the definite purpose of each index note is to indicate clearly the character and purpose of the article or paper described; and with that in view we give the following essential information about every publication:

(1) The title of the article,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published,
(7) *We supply the article itself, if desired.*

☞ The full text of every article described in the Index, together with all its illustrations, can usually be supplied by us.—See the "Explanatory Note" at the end of the Index, where also the full titles of the principal journals indexed are given.

Note—The busy engineer will also observe that the Index is conveniently classified into the larger divisions of engineering science, to the end that the reader may quickly turn to what concerns himself and his special branches of work. By this means it is possible, within a few minutes' time each month, to learn promptly of every important article published anywhere in the world, in any language, upon the subjects claiming one's special interest.

Divisions of The Engineering Index.

Civil Engineering	Page 285	Mechanical Engineering	Page 302
Electrical Engineering	" 294	Mining and Metallurgy	" 314
Industrial Economy	" 299	Railway Engineering	" 321
Marine and Naval Engineering	" 300	Street and Electric Railways	" 324

CIVIL ENGINEERING.

BRIDGES.

Arches.

The Arch Principle in Engineering and Esthetic Aspects, and Its Application to Long Spans. C. R. Grimm. Presents some suggestive designs for a bridge of several spans, carrying railroad and street traffic across a wide river, the channel span to be of the greatest length thus far used in practice. Ills. 6000 w. Pro Am Soc of Civ Engrs—Sept., 1910. No. 17556 F.

Three-Hinged Arch Vaulting Over the Saint Martin Canal, Paris. Illustrations and notes from articles by M. Mesnager, in *Le Génie Civil,* indicating the character of the work and the methods employed. 1200 w. Eng Rec—Sept. 10, 1910. No. 17047.

Bascule.

The Eight-Track Bascule Bridge at Campbell Avenue, Chicago. C. R. Dart and S. T. Smetters. Illustrated detailed description of an interesting structure.

General discussion. 6000 w. Jour W Soc of Engrs—Aug., 1910. No. 17333 D.

Concrete.

The Construction Methods on the Rocky River Bridge, with Some Costs. Sectional plans and elevations, with description of methods employed in building a bridge with a 280-ft. concrete arch span. 6500 w. Engng-Con—Sept. 14, 1910. No. 17118.

Design.

Construction of Certain Curves Applicable in the Design of Bridges (Sur le Tracé pratique de certaines Courbes transcendantes utilisables dans la Construction des Ponts). Maurice d'Ocagne. Describes a method for catenary curves, applicable also to any curve with an axis of symmetry. Ills. 4500 w. Ann d Ponts et Chaussées—1910-IV. No. 17207 E + F.

Floors.

See Masonry, under BRIDGES.

Foundations.

See Quebec, under BRIDGES.

Masonry.

Improving a Granite Viaduct—Boston & Providence Railroad. Illustrates and describes a viaduct across the Neponset River, and the method of reinforcement without interrupting traffic. 900 w. Eng Rec—Sept. 10, 1910. No. 17051.

A New Bridge at Toulouse. Illustrations and brief description of a remarkable bridge across the Garonne River, having two parallel masonry arches connected by a floor of reinforced concrete. 300 w. Sci Am—Sept. 10, 1910. No. 17018.

Experiences in the Construction of the 85-Metre Masonry Arch Over the Isonzo at Salcano (Erfahrungen und Beobachtungen beim Bau der 85*m.* weiten Wölbbrücke über den Isonzo bei Salcano). Leopold Oerley. Gives interesting data of the design and construction. Ills. Serial. 1st part. 3000 w. Zeitschr d Oest Ing u Arch Ver—Aug. 19, 1910. No. 17464 D.

Quebec.

Removal of Wrecked Superstructure, Quebec Bridge. Describes the condition of the wrecked spans, and the methods of removal adopted. 1600 w. Eng Rec—Sept. 17, 1910. No. 17153.

The Reconstruction of the Quebec Bridge. Explains the general conditions, describing the original structure, its erection and collapse, and the general design of the new structure. Ills. 2000 w. Eng Rec—Sept. 10, 1910. No. 17044.

The Plant for Constructing the Quebec Bridge Substructures. Information concerning the reconstruction, illustrating and describing the costly contractor's plant for carrying on the work. 2500 w. Eng Rec—Sept. 24, 1910. No. 17402.

Caissons for the Main Piers of the New Quebec Bridge; Launch of the North Pier Caisson. Illustrates and describes the substructure work for the new Quebec Bridge. 1500 w. Eng News—Sept. 8, 1910. No. 17005.

Caissons for the Main Piers of the New Quebec Bridge. Illustrates and describes the work in progress and methods employed. Plate. 1200 w. Engr, Lond—Sept. 2, 1910. No. 17096 A.

Reinforced Concrete.

Notes on the Construction of a Reinforced Concrete Arch Bridge, with Some Costs. W. A. Hoyt. The work described is a highway bridge of seven 80-ft. spans. Ills. 2500 w. Engng-Con—Sept. 7, 1910. No. 17025.

The Amélie-les-Bains Three-Hinged Reinforced-Concrete Arch (Pont en Béton armé, à trois Articulations, d'Amélie-les-Bains, Pyrénées-Orientales, et Applications du même Systéme de Semi-Articulations). M. Mesnager. Brief description with plate. Ills. 2500 w. Génie Civil—Aug. 27, 1910. No. 17238 D.

Steel.

Typical Compression Members in Long Span Bridges. Edgar Marburg. Gives data for comparison, relating to eight bridges. Ills. Plate. 3000 w. Eng Rec —Sept. 3, 1910. No. 16901.

Standard I-Beam Railroad Bridges Over City Streets. Illustrates and describes details of floor construction, waterproofing and expansion joint in the short span bridges of the N. Y. C. & H. R. railroad, carrying tracks over city streets. 1200 w. Eng Rec—Sept. 17, 1910. No. 17152.

The Erection of the Broad River Bridge. Describes work in North Carolina, on a single-track bridge. 1360-ft. long, and 160-ft. above water, carrying the C., C., & O. Ry. over the Broad River. Plate-Girder spans on steel towers, and a 200-ft. pin-connected deck channel span. Ills. 1600 w. Eng Rec—Sept. 17, 1910. No. 17159.

See also Testing, under BRIDGES.

Swing Bridges.

The Design of Swing-Bridges. James Athersmith Orrell. Describes types and calculates stresses. Ills. 11800 w. Inst of Civ Engrs—Students' paper, No. 636. No. 17369 N.

Testing.

Statical Tests of a Steel Bridge Over the Tanarus (Sulle Prove statiche del Ponte in Acciaio sul Tanaro). Gustavo Colonnetti. Describes the structure and the method of testing and gives results. Ills. 4500 w. Ing Ferro—Aug. 16, 1910. No. 17248 D.

Trestles.

Strengthening Old Trestles on the Wabash Railroad. Illustrates and describes the use of concrete to preserve the metal in an old trestle, and to increase the strength of the structure. 1500 w. Ry. Age Gaz—Sept. 9, 1910. No. 17015

Viaducts.

An Armored Concrete Viaduct at Rotterdam. Illustrated description of the structure and the methods of construction and reinforcement. 3500 w. Engr, Lond—Sept. 9, 1910. No. 17310 A.

CONSTRUCTION.

Bins.

Cement Storage Plant of the Croatia Portland Cement Company in Podsused near Agram (Siloanlagen der Portland-Zement-Fabrik "Croatia" A.-G. in Podsused bei Agram). S. Zipkes. A detailed description of an extensive plant. Ills. Serial. 1st part. 1000 w. Deutscher Bau—Aug. 31, 1910. No. 17294 B.

Caissons.

See Quebec, under Bridges.

Coaling Stations.

Two Concrete Locomotive Coaling Stations. W. E. Witte. Illustrates and describes recently built stations at Nicetown, Pa., and at Philadelphia. 3000 w. Eng Rec—Sept. 3, 1910. No. 16908.

Concrete.

Notes on Drilling Holes in Concrete. J. R. Taft. Gives data and cost. 700 w. Eng Rec—Sept. 3, 1910. No. 16906.

Exterior Treatment of Concrete Surfaces: Committee Report to the National Association of Cement Users. The completed report, somewhat condensed and abstracted. 6500 w. Eng News—Sept. 15, 1910. No. 17111.

Methods of Employing Concrete in Marine Structures with Data on Durability of Concrete in Sea Water and Examples of Typical Marine Structures of Concrete. Chandler Davis. Abstract of a paper read at Convention of Nat. Assn. of Cement Users. Ills. 4000 w. Engng-Con—Aug. 31, 1910. No. 16856.

Concrete Construction in Manila and the Philippine Islands. W. C. Reibling. A discussion of the materials used and the importance of investigating carefully and developing standard methods of testing. 4 plates. 6000 w. Philippine Jour of Sci—March, 1910. No. 16937 N.

Contractors' Plants.

See Quebec, under Bridges.

Cost Keeping.

Cost-Keeping in the U. S. Reclamation Service. D. W. Murphy. An explanation of the methods employed. 3000 w. Eng News—Sept. 8, 1910. No. 17002.

Engineers' Cost-Keeping System, New York State Barge Canal. An explanation of the system worked out, which has proved very satisfactory. 1000 w. Engng-Con—Sept. 7, 1910. No. 17026.

Demolition.

Demolition of the Side Wall of the Passage Between the Saint Nazaire Dry Docks (Démolition en Ventouse d'un Parement du Bajoyer du Pertuis de Communication entre les Bassins du Port de Saint Nazaire). M. le Trocquer. Describes work preliminary to an enlargement of the passage made necessary by the increased size of recent cruisers. Ills. 8000 w. Ann de Ponts et Chaussées—1910-IV. No. 17208 E + F.

Earth Subsidence.

Progressive Subsidence Near Main St., Cambridge, Mass., and the Design of the Main Street Subway. Frank H. Carter. An interesting account of slow subsidence and its effects on engineering structures. Map and profile. 3000 w. Eng News—Sept. 8, 1910. No. 17000.

Excavation.

Precautions for Maximum Safety and Effectiveness in Blasting. An illustrated discussion of the electric firing system and the general precautions for safe and effective work. 5000 w. Eng News—Sept. 22, 1910. No. 17353.

See also Ore Handling, under MECHANICAL ENGINEERING, Transporting and Conveying.

Failures.

See Reservoirs, under Water Supply.

Piling.

Method of Jetting Down Concrete Piles and Records of Output. Data relating to the making and sinking of about 200 reinforced-concrete piles, at Atlantic City. Ills. 1600 w. Engng-Con—Sept. 14, 1910. No. 17119.

Reclamation.

The Reclamation of Low Lands Near Stockton, California. Describes the character of the country and methods of reclamation work. Ills. 1600 w. Eng Rec—Sept. 5, 1910. No. 16904.

The Drainage of the Mississippi Delta. Arthur E. Morgan. Explains conditions in the Delta, and the work that has been done and proposed. Ills. 2000 w. Mfrs' Rec—Sept. 8, 1910. Serial. 1st part. No. 16979.

Reinforced Concrete.

The Economy of Reinforced Concrete Construction (Zur Frage der Wirtschaftlichkeit des Eisenbetonbaues). Fr. Baumann. Examines the relative merits of steel and reinforced concrete for large structures. 2800 w. Stahl u Eisen—Aug. 24, 1910. No. 17265 D.

The Calculation of the Deflection of Reinforced-Concrete Beams (Die Berechnung der Durchbiegung von Eisenbetonbalken). G. Kaufmann. Mathematical. 3000 w. Beton u Eisen—Aug. 2, 1910. No. 17471 F.

Pioneer Reinforced Concrete Work. Carlton Strong. An illustrated account of the construction of the Alabama, afterwards known as the Berkley Hotel, erected at Buffalo, N. Y., 1894. 5500 w. Cement Age—Sept., 1910. No. 17326.

A Reinforced Concrete Warehouse at Lowell, Massachusetts. Illustrated detailed description of a structure to be erected in the center of the business section of the city by the Mass. Cotton Mills Co. 1200 w. Cement Age—Sept., 1910. No. 17327.

See also Coaling Stations, Roofs, Stacks, and Steel, under CONSTRUCTION; Reservoirs, and Water Towers, under WATER SUPPLY; Docks, and Wharves, under WATERWAYS AND HARBORS; and Stations, under RAILWAY ENGINEERING, PERMANENT WAY AND BUILDINGS.

Retaining Walls.

Fifth Avenue Retaining Wall; Oregon & Washington, Seattle, Wash. Illustrates and describes details of a wall varying in height from 0 to 45 ft. with a total length of 1,680 ft. 400 w. Ry Age Gaz—Sept. 16, 1910. No. 17135.

Roofs.

The Gisshammer Reinforced-Concrete Roof (Universal-Betondecke "System Gisshammer"). Richard Hoffmann. Brief description of the system. Ills. 2000 w. Beton u Eisen—Aug. 2, 1910. No. 17470 F.

Stacks.

Reinforced Concrete for Chimney Construction. P. S. Sheardown. Notes on the reinforced-concrete lining of the steel chimney shafts at Ringsend station of the Dublin United Tramways Co., and on chimney construction of this material. Read at the Dublin Cong. of the Tram. & Lgt. Ry. Assn. 1500 w. Elect'n, Lond—Sept. 16, 1910. No. 17435 A.

Steel.

The Application of Steel in Building Construction (Die Verwendung von Eisen im Hochbau). A criticism, defending reinforced concrete, of Herr Fischmann's paper on this subject in *Stahl und Eisen* for May 11, 1910, with reply by Herr Fischmann. 6500 w. Stahl u Eisen—Aug. 24, 1910. No. 17266 D.

Formulas for Use in Detailing Steel Structures. Hart Vance. Aims to make available formulae developed in spherical trigonometry applicable to hoppers and various forms of towers with inclined columns or "legs." Ills. 2000 w. Eng News—Sept. 1, 1910. No. 16846.

A Steel and Reinforced Concrete Grand Stand. Illustrated detailed description of a structure in Chicago. 1500 w. Eng Rec—Sept. 3, 1910. No. 16902.

Steel Substructure, Pennsylvania Terminal Post Office. Illustrates and describes the steel-work for this new U. S. Post-Office building in New York City, which will occupy nearly all of two city blocks, and cost about $4,000,000. 2500 w. Eng Rec—Sept. 10, 1910. No. 17053.

Structural Steel Details in the Wick Building, Youngstown. Illustrates and describes details of a steel-cage building 12 stories high with grillage footings on concrete piers about 12 ft. below curb. 2000 w. Eng Rec—Sept. 24, 1910. No. 17404.

Construction of the Whitehall Building Extension. Detailed description of the addition of a 32-story extension to a 20-story building in New York City. 2200 w. Eng Rec—Sept. 3, 1910. No. 16910.

See also Steel Works, under MINING AND METALLURGY, IRON AND STEEL.

Tunnel Lining.

Concrete Lining of the Rondout Pressure Terminal. An illustrated account of the methods and equipment employed. 5000 w. Eng Rec—Sept. 17, 1910. No. 17151.

Tunnels.

The Elizabeth Tunnel. W. C. Aston. Describes methods by which the highest American hard rock tunnel record was made. Ills. 2800 w. Mines & Min—Sept., 1910. No. 16881 C.

See also Pipe Tunnels, under WATER SUPPLY.

Underpinning.

Underpinning a Factory Building. F. E. Davidson. Reviews the conditions and resulting effects on a building in Chicago, which made it necessary to construct an entirely new foundation after the building was occupied. Describes methods. Ills. 5000 w. Jour W Soc of Engrs—Aug., 1910. No. 17331 D.

A Novel Method of Jacking Caisson Piles for Underpinning. Brief illustrated description of method of underpinning the Astor Building, 16 Wall St., N. Y., by using weight of adjoining building. 600 w. Eng News—Sept. 15, 1910. No. 17109.

MATERIALS OF CONSTRUCTION.

Concrete.

See also same title, under CONSTRUCTION.

Steel Corrosion.

Rust, as Shown in the Removal of a Seventeen-Story Building. T. Kennard Thomson. Brief report of the condition of the steelwork in Gillender Building, New York City. 350 w. Pro Am Soc of Civ Engrs—Sept., 1910. No. 17557 F.

Timber.

The Strength of Fir and Pine Timber (Die Festigkeit von Fichten- und Kiefernholz). Karl Dörr. Reviews the results of various tests since 1873. 2000 w. Deutsche Bau—Aug. 17, 1910. No. 17293 B.

MEASUREMENT.

Leveling.

The Leveling Operations of the United States Government. E. M. Douglas. A brief account of the spirit leveling carried out by various government departments. Ills. 2000 w. Eng News—Sept. 15, 1910. No. 17112.

Road Resistance.

See Accelerometer, under MECHANICAL ENGINEERING, MEASUREMENT.

Surveying.

The "Interval" Method of Determining Elevations in Stadia Surveys. Adolph

F. Meyer. A discussion of the advantages of this method. 1500 w. Eng News—Sept. 1, 1910. No. 16849.

MUNICIPAL.

City Planning.

Methods of Laying Out Cities. Charles W. Barnaby. Suggested improvements for safety and transport. 3500 w. Cassier's Mag—Sept., 1910. No. 17162 B.

City Design and Transportation. M. Wattman. Abstract of a report at the Brussels meeting of the Int. St. & Int. Ry. Assn. Considers the rapid growth of cities and the importance of transportation facilities; modern ideas of city planning, etc. Ills. 2000 w. Elec Ry Jour—Oct. 1, 1910. No. 17579.

Comfort Stations.

Riverside Shelter and Comfort Station. Illustrated detailed description of a structure of Doric architecture designed with special view to the requirements of the location, near Grant's Tomb, New York. 2500 w. Munic Jour & Engr—Sept. 28, 1910. No. 17519.

Drainage.

The Drainage of the Blato-Polje on Curzola Island (Die Entwässerung des Blato-Polje auf der Insel Curzola). Josef Horowitz. Discusses a project for draining a marsh to get rid of malaria-carrying insects. Ills. 2200 w. Oest Wochenschr f d Oeffent Baudienst—Aug. 6, 1910. No. 17466 D.

Mosquitoes.

The Modern Mosquito Extermination Campaign. John B. Smith. Illustrated description of the extensive work undertaken by the state of New Jersey. 2500 w. Eng News—Sept. 1, 1910. No. 16850.

Pavements.

A Study Into the High Cost of Asphalt Pavement Repairs in Chicago in 1908-9. Abstract of a report by S. Whinery to the Chicago Commission on City Expenditures. 7000 w. Engng-Con—Sept. 21, 1910. No. 17350.

See also Roads, under MUNICIPAL.

Public Health.

Annual Convention of the American Public Health Association. A report of the 38th annual meeting at Milwaukee, Wis., with abstracts of papers read. 6000 w. Eng News—Sept. 15, 1910. No. 17110.

Refuse Disposal.

Modern Practice in Garbage Disposal. Rudolph Hering, before the Am. Pub. Health Assn. Remarks on the Milwaukee incinerator, and a discussion of the best methods now in use for the disposal of city refuse. 3500 w. Eng Rec—Sept. 24, 1910. No. 17405.

Garbage Incinerators for San Francisco. Gives description and specifications of plant and reports a study made of the composition of the refuse. 4500 w. Munic Jour and Engr—Sept. 7, 1910. No. 16983.

Roads.

The Second International Road Congress. A review of the proceedings and the questions submitted. 3500 w. Engng—Aug. 26, 1910. Serial. 1st part. No. 16965 A.

The Second International Road Congress. E. L. Corthell. Information in reference to interesting features of the Congress. Also Final Conclusions adopted at Brussels. 5000 w. Eng News—Sept. 1, 1910. No. 16847.

The Kentish Ragstone Quarries. P. Walton Harrison. Read before the Inst. of Munic. Engrs. Describes the composition of this material and its use as a road stone, and for architectural and engineering works. 2000 w. Archt, Lond—Sept. 2, 1910. No. 17072 A.

Road Making in the United States. Vernon M. Peirce. Read at the Brussels Road Cong. Discusses foundation and drainage of roads, methods of work, etc. 4000 w. Surveyor—Sept. 9, 1910. No. 17189 A.

Rectification of a National Highway as a Vicinal Road in l'Aveyron (Rectification d'une Route nationale exécutée comme Chemin vicinal dans l'Aveyron). M. Daudoux. Describes difficult road construction in France. Ills. 3000 w. Ann de Ponts et Chaussées—1910-IV. No. 17209 E + F.

Building the Holyoke Road. Illustrates and describes details of construction of an important highway in Massachusetts. 2800 w. Munic Jour & Engr—Aug. 31, 1910. No. 16831.

Road Construction and Maintenance in Large Cities. Hector F. Gullan. Read at Brussels Int. Road Cong. A discussion of methods and materials and the factors determining their choice. 3000 w. Surveyor—Sept. 2, 1910. No. 17083 A.

Construction and Maintenance of Parkway Roads. John R. Rablin. Presented at Brussels Int. Road Cong. A general description of the methods and materials used in the construction and maintenance of macadam and gravel surfaced roads in the Boston Park System. 2000 w. Engng-Con—Sept. 7, 1910. No. 17027.

The Maintenance of Roads. John M. Lynch. Deals chiefly with the causes of wear, both in the surface and in the under part of the road coating, and the methods of repair. 3000 w. Surveyor—Sept. 9, 1910. Serial. 1st part. No. 17188 A.

Work Preliminary to Road Construction and Street Pavement Maintenance. George C. Warren. Read before the convention of the Am. Soc. of Engng. Contractors. Discusses sources of deterioration from water, and from improper track construction. 2500 w. Engng-Con—Sept. 28, 1910. No. 17521.

Present Status of Dust Prevention on Roads. Gregers-Nissen in *Allgemeine*

Automobil Zeit. Deals particularly with work in Germany. 2000 w. Horseless Age—Sept. 28, 1910. No. 17569.

The Use of Binding Materials in the Construction of Macadamized Roadways. W. W. Crosby. Presented at Brussels Int. Road Cong. Discusses the use of bituminous cement as a binding material, and its proper application. 5500 w. Engng-Con—Sept. 7, 1910. No. 17028.

Bituminous Road Work in Germany. Information from a recent report of replies received to inquiries sent to 89 cities. 3500 w. Eng Rec—Sept. 17, 1910. No. 17156.

Sanitation.

The Contamination of City Air. Dr. George A. Soper. Discusses the dust evil, and other causes of contamination and the remedy, giving much information based on tests. General discussion. Ills. 9500 w. Jour Assn of Engng Socs—Aug., 1910. No. 17518 C.

See also Drainage, and Mosquitoes, under MUNICIPAL.

Sewage Disposal.

Description of Aerobic Biological Purification of Sewage by Means of the Live Earth Bed System. R. B. Owens. Illustrated description of the system. 1400 w. Can Engr—Sept. 1, 1910. No. 16915.

The Biological Purification of Sewage on Artificial Beds (Notice sur l'Epuration biologique des Eaux d'Egout sur Sol artificiel). A. Loewy. Discusses the theory of sewage purification and describes in detail a number of plants. Ills. 26000 w. Ann d Pont et Chaussées—1910-IV. No. 17204 E + F.

The Operating Control of Sedimentation Plants, from the German Viewpoint. Dr. Ing. Karl Imhoff. Deals with the control of settling basins for sewage treatment. 3000 w. Eng Rec—Sept. 3, 1910. No. 16907.

Sewage Disposal by Dilution. A summary of a chapter on the "Diffusion and Digestion of Sewage in New York Harbor," in the report of the Metropolitan Sewerage Commission of New York, giving much information concerning the discharge of sewage into tidal waters. 2200 w. Munic Jour & Engr—Sept. 14, 1910. Serial. 1st part. No. 17123.

Sewage Disposal at Saskatchewan. T. Aird Murray. Read before the Am. Health Assn. Explains reasons for the methods recommended to prevent stream pollution. 2000 w. Can Engr—Sept. 8, 1910. No. 17029.

Sewage Disposal for a Residential Colony. Illustrated description of a portion of a plant installed at Chevy Chase Lake, Md., giving its capacity and cost. 1500 w. Met Work—Sept. 24, 1910. No. 17387.

The Continued Legislative Defeat of More Stringent Control Over Sewage Disposal in New York State. Editorial discussion of the proposed legislation and its wisdom. 1700 w. Eng News—Sept. 15, 1910. No. 17108.

River Control Commissions in Relation to Sewage Disposal (Flussaufsicht in Bezug auf die Abwässer). Oskar Friedmann. Discusses river control in England, Germany, and Austria, with special reference to the last. 2000 w. Oest Wochenschr f d Oeffent Baudienst—Aug. 6, 1910. No. 17468 D.

Sewers.

Modern Procedure in District Sewer Design. W. W. Horner. An illustrated account of the design and layout of small combination sewers, the problems and importance of the work. 5500 w. Eng News—Sept. 29, 1910. No. 17526.

Drainage Improvements at Syracuse. Illustrated description of the design and construction of an intercepting sewer. 4000 w. Munic Jour & Engr—Sept. 7, 1910. No. 16980.

Louisville Sewer Outlet. Illustrates and describes the outlet structure of the sewerage system at Louisville, Ky., designed to meet unusual conditions. 1400 w. Munic Jour & Engr—Sept. 28, 1910. No. 17520.

Street Cave-in.

A Cave-in Caused by an Underground Stream at Staunton, Va. F. B. van Horn. Illustrated description of the sinking, with discussion of the causes. 1600 w. Eng News—Sept. 1, 1910. No. 16852.

WATER SUPPLY.

Bloemfontein.

Bloemfontein Additional Water Supply. Hastings Fitz Edward Peet. Explains conditions in this part of South Africa, and describes the scheme adopted for an additional water supply. Ills. 2500 w. Inst of Civ Engrs—No. 3746. No. 17371 N.

Dams.

Discharge Measurements and Formulas for Some Large Overflow Dams. W. F. Martin. Illustrated article giving useful data of value to hydraulic engineers and for other uses. 4000 w. Eng News—Sept. 29, 1910. No. 17524.

Rolling Dams for Irrigation in Mexico. Illustrated detail description of an unusual type of rolling dam. 700 w. Eng Rec—Sept. 10, 1910. No. 17052.

Construction Plant and Methods for Building an 85000 Cu. Yd. Rubble Concrete Dam. Illustrated description of the storage reservoir of 2,750,000,000 cu. ft. capacity near Rome, N. Y., to supply water for the Barge Canal. 2000 w. Engng-Con—Sept. 21, 1910. No. 17349.

Filtration.

A New Recording Loss of Head Gage for Sand Filters. F. B. Leopold. Illustrated description of a type which gives the actual loss irrespective of variation of water level above the sand bed. 800 w. Eng News—Sept. 29, 1910. No. 17528.

Modern Filter Plants. Langdon Pearse. Read before the Ill. Water Supply Assn. Illustrates and describes typical plants of the mechanical or rapid filter type and of the slow sand type. 1500 w. Can Engr—Sept. 22, 1910. No. 17410.

Operating Results of the Bubbly Creek Filter Plant, Chicago. C. A. Jennings. The chief chemist and superintendent of the interesting plant at the Chicago stock yards gives information concerning the efficiency, cost and methods of operating. Also editorial. 5000 w. Eng Rec—Sept. 24, 1910. No. 17400.

Results of Double Filtration Experiment at Albany. A detailed report of the experiments made and the results. 3500 w. Eng Rec—Sept. 3, 1910. Serial. 1st part. No. 16903.

Fire Protection.

Fire Hose Tests at the Underwriters' Laboratories, Chicago, Ill. William H. Merrill. From an address delivered before the Int. Assn. of Fire Engrs., at Syracuse, N. Y., on "The Objects of Tests and Investigations at Underwriters' Laboratories." 2200 w. Eng News—Sept. 8. 1910. No. 17003.

Forestry.

Forestry. L. W. Goodrich. Considers the relation of forestry to water-works, reviewing the conditions in the vicinity of Hartford, Conn., and the treatment recommended by foresters. Ills. Discussion. 8800 w. Jour N Eng W-Wks Assn—Sept., 1910. No. 17338 F.

Great Britain.

The Water Supplies (Protection) Bill, 1910, as Affecting the National Water Supply. E. Bailey-Denton, and George Lowthian. A discussion of conditions relating to the water supply and the legislation needed. 2000 w. Engng—Aug. 26, 1910. No. 16966 A.

Ground Waters.

The Influence of Underground Waters on Health. Baldwin Latham. Read before the Roy. San. Inst. Discusses records of well measurements, prevention of pollution, influence of low water, water and disease, etc. General discussion. 4000 w. Surveyor—Sept. 16, 1910. No. 17421 A.

Irrigation.

Irrigation by Pumping on the Patterson Ranch. G. C. Stevens. Brief illustrated description of a water supply taken from the San Joaquin River by pumping. 2500 w. Eng Rec—Sept. 10, 1910. No. 17043.

Jersey City.

Water-Pollution and Water-Purification at Jersey City, N. J. C. E. A. Winslow. A review of facts brought out in the lawsuit regarding the Jersey City water supply. Discussion. Map. 8500 w. Jour W Soc of Engrs—Aug., 1910. No. 17332 D.

Lake Michigan.

Quality of Lake Michigan as a Water-Supply for the North Shore District. Extracts from a paper by Langdon Pearse, giving results of a sanitary survey made of the part of the lake supplying water to the residential towns north of Chicago. 2500 w. Eng News—Sept. 29, 1910. No. 17525.

Pipe Storage.

The Municipal Pipe Yard at San Francisco. Illustrates and describes arrangements for storing and testing 45,000 tons of pipe, hydrants and special castings. 5000 w. Eng Rec—Oct. 1, 1910. No. 17588.

Pipe Tunnels.

Water Pipe Tunnels in Milwaukee. Explains conditions and gives illustrated description of method adopted and of construction. 1600 w. Eng Rec—Sept. 3, 1910. No. 16911.

Pollution.

The Acid Waters of Western Pennsylvania. From a paper by E. C. Trax, before the Cent. States W.-Wks. Assn. Brief discussion of the sources of pollution which tend to produce free mineral acid in these waters. 2000 w. Eng Rec—Oct. 1, 1910. No. 17591.

Purification.

Hypochlorite Treatment of Public Water Supplies; Its Adaptability and Limitations. George A. Johnson. Read before the Am. Pub. Health Assn. A summary of the present state of the system, discussing its merits and limitations. 5500 w. Eng Rec—Sept. 17, 1910. No. 17154.

Removing Iron from Water. An account of the treatment of well water at Fort Hancock. Aeration not successful. Use of calcium hydrate and filtration adopted successfully. 1800 w. Munic Jour & Engr—Sept. 7, 1910. No. 16981.

Some Experience in Treating High-Colored Water from the Penobscot River at Bangor, Me. Abstract from report of James M. Caird, giving experience with this water. 2800 w. Engng-Con—Aug. 31, 1910. No. 16857.

The Water Purification Plant of the Chicago Stock Yards. A review of the conditions as to the water purification plant, giving both the view of the stock yards company, and of the city. 2000 w. Eng News—Sept. 8, 1910. No. 16999.

The Chicago Stock Yards Water Purification Litigation. A letter from George A. Johnson discussing the chief issues which developed during the recent trial. 3500 w. Eng News—Sept. 29, 1910. No. 17530.

Reservoirs.

Concrete-Lined Reservoirs in Seattle. Illustrates and describes details of four concrete-lined reservoirs constructed for the municipal water-works system. 2500 w. Eng Rec—Sept. 24, 1910. No. 17403.

New Central Reservoir of the People's Water Company. L. L. Mills. Illustrated description of the construction at Oakland, Cal., of perhaps the largest lined reservoir on the Pacific Coast. 1500 w. Eng Rec—Oct. 1, 1910. No. 17594.

Failure of a Reinforced-Concrete Reservoir. Ernest Macartney de Burgh. An illustrated description of the reservoir, and statement of conclusions in regard to the failure. 3500 w. Inst of Civ Engrs—No. 3846. No. 17370 N.

The Ancient Irrigation and Water-Supply Tanks or Reservoirs of Ceylon. W. G. Bligh. An illustrated sketch of reservoirs constructed before the Christian era, with a brief historical review of this island and present conditions. 6500 w. Eng News—Sept. 22, 1910. No. 17351.

Secondary Supplies.

Secondary Water Supplies, Their Dangers and Value. A topical discussion, with a statement as to what secondary supplies are. Ills. 13500 w. Jour N Eng W-Wks Assn—Sept., 1910. No. 17339 F.

Sterlization.

A Sterilization Plant for Turbid Water. Describes a plant at Council Bluffs, Ia., for the treatment of Missouri River water. 1400 w. Eng Rec—Sept. 17, 1910. No. 17160.

Sterilization of Polluted Water by Ultra-Violet Rays. Kenneth C. Grant. Describes experiments in progress in the laboratory of The Sorbonne, at Paris, for the commercial sterilization of water for domestic uses, by applying ultra-violet rays. Ills. 1000 w. Eng News—Sept. 15, 1910. No. 17105.

Sterilization of Water by Means of Quartz Lamps. Max von Recklinghausen. Reviews the lamps for artificially producing ultra-violet light and their application to sterilization. Ills. 1200 w. Elec Rev, Lond—Sept. 2, 1910. No. 17076 A.

Stream Flow.

Graphical Determination of the Flow of Water in Open Canals (Grafische Berekening voorden Afvoer in open Kanalen). P. Th. L. Grinwis Plaat. A mathematical discussion, with a large chart of the Darcy and Bazin formula. Ills. 5000 w. De Ingenieur—Aug. 27, 1910. No. 17506 D.

Typhoid Fever.

Typhoid Fever in Paris and Its Environs (La Fièvre Typhoïde à Paris et en Banlieue). Paul Vincey. A comprehensive discussion of water-supply sanitation in Paris. 9500 w. Bul Soc d'Encour—July, 1910. No. 17215 G.

Water Towers.

Constructing a Concrete Standpipe. Illustrated description of a reinforced concrete standpipe recently completed at Westerly, R. I., its design and construction. 1000 w. Munic Jour & Engr—Sept. 21, 1910. No. 17379.

See also same title, under RAILWAY ENGINEERING, PERMANENT WAY AND BUILDINGS.

Water Works.

I. Annual Convention of the New England Water-Works Association. II. Convention of the Central States Water-Works Association. Gives abstracts of papers at these two conventions, with editorial discussion of "Some Water-Works Questions of the Day." 8000 w. Eng News—Sept. 29, 1910. No. 17529.

Mexico City's New Water Works System. Robert H. Murray. Illustrated description of the new supply. 1000 w. Sci Am—Sept. 24, 1910. No. 17363.

Hankow Water-Works. Richard St. George Moore. Description of the works, with illustrations. 4000 w. Inst of Civ Engrs—No. 3853. No. 17368 N.

Supplementary Works for the Water-Supply of Jeypore, Rajputana. Charles Egremont Stotherd. Brief description. 500 w. Inst of Civ Engrs—No. 3837. No. 17372 N.

Water Works Valuation.

Some Rules for Water-Works Appraisals. Opinion of U. S. Supreme Court, delivered by Judge Lurton, in City of Quebec v. Omaha Water Co. 4800 w. Eng Rec—Sept. 10, 1910. No. 17050.

Valuation of the Fond-du-Lac Water-Works. Reviews the principles on which the Railroad Commission of Wisconsin based its findings. 3500 w. Eng Rec—Sept. 3, 1910. No. 16909.

WATERWAYS AND HARBORS.

Canals.

The Rafting of Timber on Canalized Rivers (Flossholtztransport auf kanalisierten Flüssen). Discusses conditions in Austria. 8000 w. Oest Wochenschr f d Oeffent Baudienst—Aug. 27, 1910. No. 17469 D.

Débris Barrier.

The Failure of the Yuba River Débris Barrier, and the Efforts Made for Its Maintenance. On the failure of this structure constructed for the control of hydraulic mining in California. Ills. 3000 w. Pro Am Soc of Civ Engrs—Sept., 1910. No. 17558.

Diving.

The Physics of Diving. Abstracted from "Submarine Appliances and Their Uses, etc." Illustrated description of curious effects of water pressure, showing types of diving dresses. 2000 w. Sci Am Sup—Oct. 1, 1910. No. 17540.

Docks.

Dock and Wharf Equipment. John Llewellyn Holmes. Deals with equipment for the landing and shipping, storage and delivery of mixed or general cargo, excluding bulk cargoes. Ills. 2500 w. Inst of Civ Engrs—No. 3850. No. 17374 N.

Novel Submarine Concrete Work. Frank C. Perkins. Illustrates and describes a pontoon method of concrete construction at Goderich, Canada. 1500 w. Sci Am Sup—Sept. 17, 1910. No. 17133.

Dry Docks.

The Otago Graving Dock, Port Chalmers, New Zealand. Robert Hay. Brief description. 1200 w. Inst of Civ Engrs—No. 3854. No. 17373 N.

An Electrically Operated Floating Dry Dock. Illustrated description of the Robins dock at Brooklyn, N. Y. 800 w. Elec Rev, N Y—Sept. 3, 1910. No. 16890.

Flood Prevention.

Vienna Continually Threatened by the Danube (Wien von den Hochfluten der Donau dauernd bedroht). Anton Waldvogel. Outlines the history of Danube floods, shows Vienna's danger, and discusses means of protection. Discussion. Ills. 2500 w. Zeitschr d Oest Ing u Arch Ver—Aug. 12, 1910. No. 17463 D.

The Protection of Vienna Against the Danube Floods (Der Schutz von Wien gegen die Hochwässer der Donau). Ernst Lauda. Two papers, with discussion, on the regimen of the Danube, and the flood-prevention works projected. Ills. 3000 w. Zeitschr d Oest Ing u Arch Ver—Aug. 12, 1910. No. 17462 D.

Floods.

Report of the Paris Flood Commission (Le Rapport de la Commission chargée de Rechercher les Causes des Inondations et les Moyens d'en Empêcher le Retour). A. Dumas. A review of the report of a Commission appointed to investigate the causes of floods and means of prevention. Ills. 7000 w. Génie Civil—Aug. 13, 1910. No. 17235 D.

Leghorn.

The Leghorn Harbor Project (Il Piano regolatore del Porto di Livorno). Describes the work recently initiated. Ills. 5200 w. Ing Ferro—Aug. 1, 1910. No. 17247 D.

Levees.

East Side Levee and Sanitary District, East St. Louis. Describes the levee and drainage project and gives reasons for the large expenditure involved. 2000 w. Eng Rec—Sept. 17, 1910. No. 17155.

Manzanillo.

Port of Manzanillo. M. L. Gilmore. Illustrated description of the Pacific coast port of the National Railroads of Mexico, with information regarding it. 1800 w. Marine Rev—Sept., 1910. No. 17127.

Mechanical Locks.

Hoisting Boats Electrically. Frank C. Perkins. Illustrates and describes the Anderton electric-driven canal-boat elevator. 2000 w. Sci Am Sup—Sept. 3, 1910. No. 16870.

Reconstruction of Canal-Boat Lift on the River Weaver at Anderton. John Arthur Saner. An account of the reconstruction in 1906-8. Ills. 4000 w. Inst of Civ Engrs—No. 3860. No. 17375 N.

Panama Canal.

Recent Progress at Panama. Fullerton L. Waldo. An illustrated report of recent personal observations. 2500 w. Engineering Magazine—Oct., 1910. No. 17546 B.

Piers.

Costs of Building a Timber Pleasure Pier on Pile Bends. Benjamin Brooks. Data in regard to a small pleasure pier on the coast of California. 1400 w. Engng-Con—Sept. 28, 1910. No. 17523.

The Reconstruction of the Tyne North Pier. Ivan Collingwood Barling. Reviews the history of the Tyne harbor works, specially considering the reconstruction of the outer portion of the north pier, and the reinstatement of a further length shoreward. Also general discussion. Ills. 34500 w. Inst of Civ Engrs, No. 3857—Jan. 25, 1910. No. 17365 N.

Pollution.

The Sewage Question and Treatment of Trade Effluents. John D. Watson. Read before the Roy. San. Inst. Discusses British laws relating to the pollution of rivers, and alterations needed. 3500 w. Surveyor—Sept. 16, 1910. No. 17420 A.

Soil Erosion.

The Mechanism of River Beds. V. Lokhtine. A study of the mechanical action of rivers. Ills. 4500 w. Cassier's Mag—Sept., 1910. Serial. 1st part. No. 17164 B.

Tides.

The Field and Cust Tide-Recorder. Illustrated description of a new design. 1200 w. Engng—Aug. 26, 1910. No. 16963 A.

Floats for Studying Tides. Illustrates and describes the kinds of floats used by the Metropolitan Sewerage Commission of New York, and their methods of study. 1500 w. Munic Jour & Engr—Sept. 7, 1910. No. 16984.

Trieste.

Report of a Student Excursion to the Trieste Harbor Works (Bericht über die Studienreise Zur Besichtigung der Triester Hafenanlagen). A brief description of the harbor works and recent improvements. Ills. Serial. 1st part. 3000 w. Zeitschr d Oest Ing u Arch Ver—Aug. 19, 1910. No. 17465 D.

Water Powers.

Water-Power Sites. Extract from a speech by President Taft at St. Paul, on the government's duty to prevent monopoly and extortionate charges. 1300 w. Eng Rec—Sept. 10, 1910. No. 17048.

The Prevention of Power Monopoly. Herbert Knox Smith. Extracts from a speech at St. Paul, on the water powers of the United States and hydroelectric development. 2000 w. Eng Rec—Sept. 10, 1910. No. 17045.

Wharves.

Ligno-Concrete: An Early Form of Reinforced Construction. Thomas Parker. Describes a method of wharf-building in Australia, which claims entire protection against the teredo. 500 w. Sci Am—Sept. 10, 1910. No. 17019.

ELECTRICAL ENGINEERING.

COMMUNICATION.

Radiotelegraphy.

Wireless Telegraphy and Telephony. H. Marchand. A review of progress since 1908. 1800 w. Sci Am Sup—Sept. 17, 1910. No. 17115.

Recent Patents in Wireless Telegraphy. W. H. Eccles. A review of recent improvements and their benefits. Ills. 2000 w. Elect'n, Lond—Sept. 2, 1910. Serial. 1st part. No. 17079 A.

Recent Progress in Radiotelegraphy and Radiotelephony (Progrès récents en Radiotélégraphie et Radiotéléphonie). H. Marchand. A review of progress during 1909. 2500 w. Rev Gen d Sci—Aug. 15, 1910. No. 17221 D.

Propagation of Electric Ether Waves. F. G. Cresswell. Read before the Vic. Inst. of Elec. Engrs. Considers mechanical vibration as applied to ether waves used in wireless telegraphy. 1500 w. Aust Min Stand—Aug. 3, 1910. No. 16978 B.

Abnormal Transmission of Electromagnetic Waves. Paul Schwarzhaupt. Abstract translation from *Elek. Zeit.* Reports observations of variations in intensity. 700 w. Elect'n, Lond—Aug. 26, 1910. No. 16952 A.

Commercial Wireless Telegraphy in Japan. Wichi Torikata. An account of the development with illustrated description of the Teishinsho system. It is a spark system as regards its transmitter, and uses a telephone and detector for its receiver. 3000 w. Elect'n, Lond—Sept. 16, 1910. No. 17431 A.

An Oscillation Detector Actuated Solely by Resistance Temperature Variations. W. H. Eccles. Abstract of paper read before the Phys. Soc. Describes experiments on a detector of the crystal rectifier type. 1000 w. Elect'n, Lond—Aug. 26, 1910. No. 16948 A.

Effect of Damping Factor Upon the Sensibility of Detectors in Wireless Telegraphy. H. H. Gordon. A report of tests made at the experimental wireless station of George Washington University. 1600 w. Elec Rev, N Y—Sept. 10, 1910. No. 17068.

Natural and Forced Air Circulation Across Spark-Gaps. Illustrated description of a spark-gap ventilating system which is said to increase greatly the efficiency of a wireless transmitter. 700 w. Elec Wld—Sept. 29, 1910. No. 17534.

Coherers and Their Applications to Radiotelegraphy and Telemechanics (Les Radioconducteurs et leurs Applications à la Télégraphie et à la Télédynamique sans Fil). E. Branly. Discusses their theory, construction, operation and uses. Ills. 7600 w. Bul Soc d'Encour—July, 1910. No. 17216 G.

Wireless for a Transatlantic Airship. F. M. Sammis. Illustrates and describes the equipment for the dirigible balloon *America.* 700 w. Elec Wld—Sept. 8, 1910. No. 16993.

Wireless Transmission of Time Signals from the Paris Observatory to Residences and Ships (L'Heure de l'Observatoire de Paris reçue à Domicile et à Bord des Navires par la Télégraphie sans Fil). M. Aliamet. Describes the wireless time service from the Eiffel Tower. Ills. 2400 w. L'Elecn—Aug. 20, 1910. No. 17227 D.

See also Wave Meters, under MEASUREMENT.

Telegraphy.

The Santano Duplex System of Telegraphy for Aerial Lines (Telegrafia Duplex por Lineas aéreas, sistema Santano). Miguel Pérez Santano. Begins a description of the author's system. Ills. Serial. 1st part. 1500 w. Energia Elec—Aug. 10, 1910. No. 17250 D.

Telephone Exchanges.

New Post Office Telephone Exchange, Glasgow. Illustrated description of a new exchange on the common-battery system. 1200 w. Elec Rev, Lond—Aug. 26, 1910. Serial. 1st part. No. 16943 A.

Telephony.

Central-Battery versus Magneto Systems in Small Exchanges. E. A. Hawkins and E. M. Wier. Abstract of paper before the So. Ind. Tel. Assn. Compares them from service and cost standpoints. 4000 w. Elec Rev, N Y—Sept. 3, 1910. No. 16892.

DYNAMOS AND MOTORS.

A. C. Motors.

Three-Phase Commutator Motors with Speed Regulation (Drehstromkollektormotoren mit regelbarer Umlaufzahl). Describes the construction and testing of the Winter-Eichberg motor at the works of the Union E.-G. Ills. 2000 w. Zeitschr d Ver Deutscher Ing—Aug. 20, 1910. No. 17497 D.

D. C. Dynamos.

How to Design a Constant-Potential Direct-Current Dynamo. W. T. Ryan. A brief statement of the fundamental principles upon which the design necessarily rests. 2500 w. Elec Rev, N Y—Sept. 17, 1910. Serial. 1st part. No. 17170.

Parallel Operation of Direct Current Generators. C. L. Greer. Gives requisites for satisfactory operation. Ills. 1400 w. Power—Sept. 27, 1910. No. 17513.

Exhibitions.

Electrical Machines from the Netherlands at the Brussels Exposition (Eenige

Mededeelingen over electrische Machines in de Nederlandsche Afdelling der Internationale Machinegalerij op de Wereldtenoonstelling te Brussel). Th. Rosskopf. Illustrated description of the exhibits. 5000 w. De Ingenieur—Aug. 13, 1910. No. 17504 D.

Failures.

Breakdowns of Electrical Machinery. Michael Longridge. A summary of some of the more important and instructive cases of breakdown during the year 1909. Ills. 3000 w. Mech Engr—Sept. 2, 1910. No. 17087 A.

Induction Motors.

Variable Speed Induction Three-Phase Motor with Five-Speed Steps. Illustrated description of the construction of the Oerlikon variable-speed induction motor. 1000 w. Prac Engr—Sept. 9, 1910. No. 17187 A.

Iron Losses.

Iron Losses in Rotary Magnetization (Die Eisenverluste bei drehender Magnetisierung). R. Hiecke. Discusses recent papers on iron losses by Herrmann and Czepek. Ills. 3500 w. Elektrotech u Maschinenbau—Aug. 14, 1910. No. 17485 D.

Railway Motors.

The Destinies of 500-Volt D. C., 1200-Volt D. C., and 6600-Volt A. C. Motors. W. E. Davis. Abstract of paper before the Cent. Elec. Ry. Assn. Remarks on the rapid development in the production and distribution of electrical energy and the future outlook. 2500 w. Elec Ry Jour—Sept. 24, 1910. No. 17391.

Repulsion Motors.

Single-Phase Commutator Motor. Shiro Sano. Considers the effect of extra reactance in the armature circuit on the performance of the repulsion motor. 2000 w. Elec Wld—Sept. 8, 1910. No. 16994.

Speed Regulation.

See Electric Pumping, under MECHANICAL ENGINEERING, Hydraulic Machinery.

Standard Apparatus.

Standard Apparatus. Rudolph E. Hellmund. Suggestions for its use in connection with special frequencies, wherever conditions will allow. 5000 w. Elec Jour—Sept., 1910. No. 16823.

ELECTRO-CHEMISTRY.

Electric Furnaces.

The Oerlikon Electric Crucible Furnace (Fours électriques à Creuset Oerlikon). J. A. Montpellier. Brief description. Ills. 1500 w. L'Elecn—Aug. 27, 1910. No. 17228 D.

Electroplating.

Notes on the Method Employed for Refinishing Old Chandeliers and Gas Fixtures. Illustrated directions for the work. 2000 w. Brass Wld—Sept., 1910. No. 17140.

Nitrogen.

The Industrial Fixation of Atmospheric Nitrogen (Fixation industrielle de l'Azote atmospherique). E. Lamy. Describes the various processes and the products, and examines the economic possibilities of nitrogen fixation. Ills. 8000 w. Mem Soc Ing Civ de France—July, 1910. No. 17202 G.

ELECTRO-PHYSICS.

Cells.

Dry Cell Tests. F. H. Loveridge. Abstract of paper read before the Am. Elec-Chem. Soc. Gives data regarding the fall of E. M. F. and increase in internal resistance of dry cells under ordinary working conditions. 2500 w. Elect'n, Lond—Aug. 26, 1910. No. 16947 A.

Coherers.

See also Radiotelegraphy, under Communication.

Electromechanics.

The Laws of Electromechanics. Prof. Silvanus P. Thompson. Abstract of a paper before the British Assn. A summary of the laws governing electromagnetic apparatus, pointing out some of the relations between them. 800 w. Elect'n, Lond—Sept. 16, 1910. No. 17432 A.

High-Tension Discharges.

A New Method for Producing High-Tension Discharges. Prof. Ernest Wilson and W. H. Wilson. Read before the British Assn. Brief explanation, with statement of advantages gained. 600 w. Elect'n, Lond—Sept. 9, 1910. No. 17300 A.

Hysteresis.

Hysteresis. Reference is made to a paper by Morton G. Lloyd, before the Franklin Institute, on the bearing hysteresis loss has upon the design of electrical machines. . Briefly considers core material, especially "Stalloy." 1500 w. Engr, Lond—Sept. 2, 1910. No. 17099 A.

Physical Quantities.

Physical Quantities. Classified in the Order of Their Dimensional Formulas. Carl Hering. Tabulated classifications, with notes. 2500 w. Jour Fr Inst—Sept., 1910. No. 17335 D.

GENERATING STATIONS.

Accumulators.

Storage Batteries in Army and Navy Service. E. L. Reynolds. Brief review of some recent uses by the British Government, with details of construction and operation. 1500 w. Elec Engr, Lond—Sept. 2, 1910. No. 17075 A.

Auxiliary Plants.

Internal-Combustion Engines in Water-Power Plants (Die wirtschaftliche Bedeutung des Verbrennungsmotors für die Ausnutzung von Wasserkräften). Compares the advantages of Diesel motors and steam engines as auxiliaries in hydro-electric plants. Ills. 1500 w. Die Turbine—Aug. 5, 1910. No. 17298 D.

Boosters.

Limited-Current Boosters in Buffer Installations (Zusatzmaschinen mit Strombegrenzung in Pufferanlagen). J. Jonas. A discussion of the use of a booster in connection with storage batteries, with special reference to booster excitation. Ills. 2800 w. Elek Kraft u Bahnen—Aug. 4, 1910. No. 17477 D.

Central Stations.

Central-Station at Attleboro, Mass. Illustrated description of a station where steam turbines displaced reciprocating engines in an installation of moderate size. 2500 w. Elec Wld—Sept. 15, 1910. No. 17136.

Turbine Station of the Bisbee Improvement Company. I. A. Rosok. Gives results obtained in the operation of a small Arizona oil-burning plant, with details of losses and their distribution. Ills. 2000 w. Elec Wld—Sept. 22, 1910. No. 17358.

Gas and Oil-Burning Electric Power Station. Illustrates and describes the modern equipment of the Light and Traction Co., of Fort Smith, Ark. 2500 w. Elec Wld—Sept. 1, 1910. No. 16842.

Electricity Supply in Maceio, Brazil. Andrew McPherson. Illustrated description of the electric lighting system, as an example of what can be done in medium-sized towns of S. America. 2000 w. Elec Rev, Lond—Sept. 9, 1910. No. 17195 A.

Mechanical Features of a Power Plant at Landy, France. Warren H. Miller. Illustrates and describes an installation for electric light and power. 2800 w. Eng Rec—Sept. 3, 1910. No. 16905.

Design.

Elements of Power-Station Design. W. B. Gump. The present number discusses preliminary considerations and requirements. 4800 w. Elec Rev, N Y—Sept. 3, 1910. Serial. 1st part. No. 16891.

Economics.

Restricted-Hour System of Power Supply. P. J. Pringle. Presents the advantages and possibilities of this system of supply. 3500 w. Elec Rec, Lond—Aug. 26, 1910. Serial. 1st part. No. 16945 A.

Hydro-Electric.

Hydro-Electric Installations of Sweden. Aubrey V. Clayton. Abstract of paper before the Inst. of Elec. Engrs. Illustrates and describes some of the plants. 4000 w. Mech Engr—Sept. 2, 1910. Serial. 1st part. No. 17086 A.

The Ventavon Hydro-Electric Plant (L'Usine hydraulico-électrique de Ventavon, Hautes-Alpes). M. de Kermond. Brief description of a 24,000 horse-power plant on the durance, in Southern France. Ills. 2000 w. L'Elecn—Aug. 27, 1910. No. 17229 D.

The Aue Power Plant of the Baden Electric Company (Die Wasserkraftanlage Aue der Elektrizitätsgesellschaft Baden). Illustrated description. Serial. 1st part. 1500 w. Schweiz Bau—Aug. 20, 1910. No. 17297 B.

The Realization of the Walchensee Power Plant (Die Verwirklichung des Walchensee-Kraftwerkes) A review of this important power project in Bavaria. Ills. 2000 w. Deutsche Bau—Aug. 3, 1910. No. 17291 B.

The Hydro-Electric Plant at the Salto de Bolarque (Das Wasserkraft-Elektrizitätswerk am Salto de Bolarque). K. Meyer. Detailed description of the plant at this fall on the Tajo, Spain. Ills. Serial. 1st part. 3300 w. Zeitschr d Ver Deutscher Ing—Aug. 20, 1910. No. 17495 D.

Isolated Plants.

A Recent Isolated Plant Installation for Country Residence Lighting. W. D. Cassin. Brief description of a plant for an estate near Annapolis, Md. 500 w. Elec Wld—Sept. 8, 1910. No. 16992.

The Power Plant of the Bigelow Carpet Company. Illustrated description of a new plant at Clinton, Mass., to run two mills an eighth of a mile apart. 1800 w. Eng Rec—Sept. 17, 1910. No. 17157.

Regulations.

Standard Rules for the Construction and Operation of Electrical Plants Adopted 1910 by the Italian Electrical Association (Testo definitivo delle Norme per l'Esecuzione e l'Esercizio degli Impianti elettrici Adottato nell'Anno 1910). Gives the full text of the rules. Serial. 1st part. 1500 w. Industria—Aug. 21, 1910. No. 17245 D.

Rates.

Demand and Diversity Factors and Their Influence on Rates. J. R. Cravath. A brief study, giving some of the available figures. 3500 w. Elec Wld—Sept. 8, 1910. No. 16995.

The Price of Electricity. Edw. W. Cowan. Slightly abbreviated paper read before the Economic Sec. of the British Assn. Criticises the principles on which the charges are based, and favors classified tariffs. 2500 w. Elect'n, Lond—Sept. 9, 1910. Serial. 1st part. No. 17199 A.

The Price of Electricity. A summary of a paper by Edw. W. Cowan, read before the Economic Sec. of the British Assn. With notes on the paper and discussion. 3000 w. Elec Rev, Lond—Sept. 9, 1910. No. 17196 A.

The Rate Problem in Municipal Plants (Zur Tariffrage für Städtische gewerbliche Anlagen). Kasimir Gajczat. A discussion of the problem of rate fixing in municipal light and power plants. 3500 w. Elektrotech u Maschinenbau—Aug. 21, 1910. No. 17486 D.

Switches.

High-Tension Oil Switches (Hochspannung-Oelschalter). Describes the types manufactured by the Felten & Guilleaume-Lahmeyerwerke. Ills. 2300 w. Elektrotechniker—Aug. 25, 1910. No. 17472 D.

LIGHTING.

Arc Lamps.

Applications of the Electric Arc. A. J. Mitchell. A résumé of the developments in arc lamp electrodes, considered only as a source of light. 2200 w. Elec Rev, N Y—Sept. 10, 1910. No. 17066.

Illumination.

Modern Lighting. C. Toome. Gives tables of illumination data and a design chart which the writer has compiled, with notes. 1800 w. Elec Rev, Lond—Sept. 9, 1910. No. 17197 A.

Lighting of Schools. Discusses the effect on the health, and on the eye-sight, with suggestions. 2000 w. Elec Wld—Sept. 8, 1910. No. 16996.

Lighting the Morgan Art Galleries at Hartford. Describes the novel lighting of these art galleries, illustrating new ideas as applied to indirect lighting. 1700 w. Elec Rev, N Y—Sept. 10, 1910. No. 17064.

Incandescent Lamps.

The Reflecting Power of Various Metals. W. W. Coblentz. Reports experiments to obtain knowledge of the optical properties of the metals used in incandescent lamps. 7000 w. Jour Fr Inst—Sept., 1910. No. 17334 D.

Discussion on "Metal Filament Lamps," New York, May 17, 1910. Discussion of John W. Howell's paper. 5000 w. Pro Am Inst of Elec Engrs—Sept., 1910. No. 17343 F.

Tungsten Lamps. G. S. Merrill. Describes the process of producing these lamps and the care required. Also shows the performance of the lamps in service, explaining the reason of the high efficiency. 4500 w. Pro Am Inst of Elec Engrs—Sept., 1910. No. 17340 F.

Development and Application of the Tungsten Lamp for Sign Lighting in Minneapolis, Minn. Robert W. Clark. An illustrated account of development. 1800 w. Elec Wld—Sept. 1, 1910. No. 16845.

Comparative Life Test of Incandescent Lamps. Clayton H. Sharp and Preston S. Millar. Shows the agreement of British and American methods of making life tests. 1500 w. Elec Wld—Sept. 22, 1910. No. 17359.

Comparative Life Tests on Glow Lamps. C. C. Paterson and E. H. Rayner. A report of tests undertaken to determine the agreement which it is possible to obtain when life tests are carried out on glow lamps at different laboratories. 1200 w. Elect'n, Lond—Sept. 9, 1910. No. 17198 A.

Lighting by Incandescence (L'Eclairage par Incandescence). Capt. Nicolardot. Discusses recent progress in the materials, processes of manufacture, and efficiency of incandescent lamps. Ills. 7500 w. Tech Mod—Aug., 1910 (Sup.). No. 17223 D.

Mercury Vapor Lamps.

The Quartz-Tube Mercury Arc Lamp. J. G. Zimmerman. Illustrated description of this lamp and its operation. 2000 w. Elec Rev, N Y—Sept. 10, 1910. No. 17065.

See also Sterilization, under CIVIL ENGINEERING, WATER SUPPLY.

Photometry.

The Status of Heterochromatic Photometry. Herbert E. Ives. Reviews present knowledge of comparing illuminations of different colors, and outlines experimental work yet needed. 4500 w. Elec Rev, N Y—Sept. 10, 1910. No. 17063.

Photo-Electric Properties of the Alkali Metals. F. K. Richtmyer. Abstract of two papers read before the Am. Phys. Soc. Describes experiments to ascertain the dependence of photo-electric current on the wave-lengths of the incident light, and suggests useful applications of the photo-electric properties cf alkali metals. 2000 w. Elect'n, Lond—Aug. 26, 1910. No. 16949 A.

Signs.

Animated Electric Advertising Sign. S. D. Levings. Illustrated description of work in this field. 1500 w. Elec Wld—Sept. 29, 1910. No. 17535.

Street.

Street Illumination. James R. Cravath. Deals principally with electric lighting and the relation and arrangement of lamps. Short discussion. 4000 w. Jour Assn of Engng Socs—July, 1910. No. 16827 C.

Some Recent Tendencies in Street Lighting. Louis Bell. On the use of improved illuminants, discussing their arrangement, location, and related matters. 2200 w. Elec Rev, N Y—Sept. 10, 1910. No. 17067.

Ornamental Street Lighting in the Middle West. Illustrates and describes attractive arrangements of the lighting units, and gives tabulated data of cost, operation, etc. 1000 w. Elec Wld—Sept. 15, 1910. No. 17138.

Ornamental Street Lighting. Abstract of a paper by E. Darrow, read before the Indiana Elec. Lgt. Assn. Illustrated discussion of the kinds of illuminants and the cost of operation. 2500 w. Elec Wld—Sept. 8, 1910. No. 16997.

Street-Lighting Practice in Massachusetts. Gives details of street-lighting service in a number of the larger cities served by private plants. 4000 w. Elec Wld—Sept. 1, 1910. No. 16844.

MEASUREMENT.

Dynamometers.

See also same title, under MECHANICAL ENGINEERING, MEASUREMENT.

Insulation Testing.

Defects in the Voltmeter Method of the Measurement of Insulation Resistance. Arthur J. Rowland. Points out some of the limitations and defects of the voltmeter. 1600 w. Elec Wld—Sept. 1, 1910. No. 16843.

Laboratories.

Physical Laboratory of the National Electric Lamp Association. Illustrates and describes a laboratory in Cleveland, Ohio, for research in illumination and electric lighting. Also a sketch of the life of the director, Dr. Edward P. Hyde. 3500 w. Elec Rev, N Y—Sept. 10, 1910. No 17062.

Potentiometers.

The Drysdale-Tinsley Alternating-Current Potentiometer (Potentiomètre Drysdale-Tinsley pour Courant alternatif). M. Aliamet. Discusses the theory, construction, and uses of the instrument. Ills. 2700 w. L'Elecn—Aug. 6, 1910. No. 17225 D.

Power Factor.

Practical Notes on New Methods of Measuring Apparent Power and Power Factor (Considerazioni pratiche per l'Applicazione dei nuovi Metodi di Misura industriale della Potenza apparenté e del Fattore di Potenza). Riccardo Arno. Discusses the use of watt meters, volt-coulomb meters and phase meters. Ills. 2500 w. Monit Tech—Aug. 30, 1910. No. 17241 D.

Resistance.

See Thermometry, under MEASUREMENT.

Station.

The Wil Measurement Station of the Kubel Electrical Plant (Die Messtation Wil des Elektrizitätswerkes Kubel). F. Largiarder. Describes the equipment of a large measuring plant on an extensive transmission network in Switzerland. Ills. 2000 w. Schweiz Bau—Aug. 13, 1910. No. 17296 B.

Thermometry.

Electrical Recording Thermometers for Clinical Work. H. L. Callendar. Abstract of presidential address to the Physical Soc. Discusses conditions of sensitiveness in measuring a resistance by the Wheatstone bridge method, and describes the construction of electrical resistance thermometers and recorders for clinical work. Ills. 5500 w. Elect'n, Lond—Sept. 2, 1910. No. 17081 A.

Wave Meters.

The Development of the Wave-Meter in Wireless Telegraphy. George Seibt. Discusses the history of wave-meter development. Ills. 2500 w. Elec Wld—Sept. 29, 1910. No. 17533.

POWER APPLICATIONS.

Organ Blower.

Organ Blowing by Means of Electricity. Illustrates and describes the Sentinel organ blower, installation and its operation. 1200 w. Elec Rev, Lond—Sept. 9, 1910. No. 17194 A.

TRANSMISSION.

Cables.

Notes on High-Tension Underground Cables. R. E. Neale. Considers methods of laying underground mains, life and causes of breakdowns, the limiting and test voltages, etc. 2500 w. Elec Rev, Lond—Sept. 16, 1910. No. 17428 A.

The Dielectric Properties of Modern High-Tension Cables. M. Höchstadter. Abstract translation from *Elektrotechnische Zeit.* Describes experiments made on paper cables at high pressures to determine the dielectric losses in the insulation. Ills. 4500 w. Elect'n, Lond—Sept. 2, 1910. No. 17080 A.

Capacity.

The Electrostatic Capacity Between Equal Parallel Wires. H. Pender and H. S. Osborne. A criticism of values given in the *General Electric Review,* showing the errors. 1500 w. Elec Wld—Sept. 22, 1910. No. 17360.

Fault Location.

An Overlap Loop Test. Daniel Shirt. Deals with a particular method of applying the Murray test, which he thinks possesses distinct advantages. 1500 w. Elect'n Lond—Aug. 26, 1910. No. 16951 A.

Insulators.

The Design and Efficiency of High-Tension Insulators. A. O. Austin. Abstract of a paper read before the Cent. Elec. Ry. Assn. Discusses types and their development, concluding that when the properties which produce reliability are fully understood, most of the troubles of transmission due to defective insulation will disappear. Ills. 2000 w. Elec Ry Jour—Sept. 24, 1910. No. 17390.

Discussion on "The Application of Porcelain to Strain Insulators" and "Electric Railway Catenary Construction," New York, May 27, 1910. Discussions on papers by W. H. Kempton, and by W. N. Smith. 10000 w. Pro Am Inst of Elec Engrs—Sept., 1910. No. 17344 F.

Line Design.

Transmission Line Calculations. Alfred Still. Discusses the inductance of electric transmission lines as effected by the subdivision of the circuits and the arrangement of the conductors. 1500 w. Elec Wld—Sept. 15, 1910. No. 17137.

Tension and Sag in High-Voltage Lines (Spannung und Durchhang in Starkstromleitungen). F. Schauer. A discussion of the regulations of the Verband Deutscher Elektrotechniker. Ills. 2500 w. Elek Kraft u Bahnen—Aug. 24, 1910. No. 17482 D.

The Influence of the Diversity Factor on Transmission-Line Design (Der Einfluss des Verschiedenheitsfaktors auf die Dimensionierung elektrischer Leitungen). Carl Richter. Mathematical. Ills. 1500 w. Elektrotech u Maschinenbau—Aug. 14, 1910. No. 17484 D.

Poles.

Telephone Poles and Pole Lines. F. L. Rhodes. Abstract of paper read before the N. Eng. Tel. Soc. Discusses pole timbers, pole specifications, concrete poles, preservation, cross-arms, insulator pins and live wire. 3500 w. Elec Rev, N Y—Sept. 17, 1910. No. 17171.

Towers.

Steel Transmission Towers. J. Edw. Jennings. Read before the Brooklyn Engrs. Club. General description of the industry of steel transmission towers, used to support high tension electric lines. Ills. 4000 w. Can Engr—Sept. 22, 1910. No. 17411.

Transformers.

The Dimensioning of Three-Phase Transformers (Die Dimensionierung von Drehstromtransformatoren). Karl Metzler. Mathematical discussion of their design and calculation. Ills. 3000 w. Elektrotech u Maschinenbau—Aug. 28, 1910. No. 17448 D.

Voltage Regulation.

Voltage Regulation. Discusses the importance of voltage regulation, considering the regulation of the bus-bar pressure and the boosting of continuous-current feeders; also alternating-current feeder regulators, discussing types. 3500 w. Engr, Lond—Sept. 2, 1910. No. 17097 A.

Wires.

Notes on Conductors for Heavy Alternating Currents. K. C. Randall. 1500 w. Elec Jour—Sept., 1910. No. 16824.

MISCELLANY.

Copper.

The Temperature Coefficient of Resistance of Copper. J. H. Dellinger. Brief account of experimental investigations showing that the temperature coefficient was substantially proportional to the conductivity. 1000 w. Jour Fr Inst—Sept., 1910. No. 17337 D.

Electric Clocks.

Electric Clocks (L'Horlogerie électrique). M. Béache. A description of the methods and apparatus of electrical transmission of time signals. Ills. Serial. 1st part. 4000 w. Génie Civil—Aug. 6, 1910. No. 17233 D.

Insulating Materials.

The Invention of "Protal." Dr. F. G. Wiechmann. Abstract of a paper read before the Am. Inst. of Chem. Engrs. Describes a new product which can be used where rubber and similar materials are now employed. 4500 w. Sci Am Sup—Sept. 10, 1910. No. 17024.

INDUSTRIAL ECONOMY.

Accounting.

Monthly Profit and Loss Determination in Manufacturing Plants (Monatliche Gewinn- und Verlustabrechnungen). E. Blum. Discusses the method of determining profit and loss. 1700 w. Tech u Wirt—Aug., 1910. No. 17501 D.

Arbitration.

The Story of an Arbitration. Clarence Deming. An account of the arbitration in Connecticut between the street railway corporation of the state and its conductors and motormen. 3000 w. Ry Age Gaz—Sept. 16, 1910. No. 17133.

Cost Systems.

Cost Keeping in Small Factories. Paul R. Powell. Explains a system of giving exact information adequate for a moderate sized plant. 1500 w. Engineering Magazine—Oct., 1910. No. 17548 B.

The Distribution of Foundry Costs (Arbeitszeit- und Ausführungsverteilung im Giessereiwesen). W. Heym. A detailed discussion of cost systems for foundries. Ills. Serial. 1st part. 1200 w. Giesserei-Zeit—Aug. 1, 1910. No. 17273 D.

See also Management, under INDUSTRIAL ECONOMY.

Education.

The Relation of Science to Industry and Commerce. R. Blair. Read before the Educational Sci. Sec. of the British Assn., at Sheffield. Considers chiefly the relation which exists between the scientific and technical education provided at higher institutions in England, and the after careers of students. 14000 w. Nature—Sept. 15, 1910. No. 17378 A.

Theory and Practice. Arthur Bowes. Read at Manchester, Eng., before the Inst. of Munic. Engrs. Remarks on the value of each and the wisdom of their combination. 2500 w. Surveyor—Aug. 26, 1910. No. 16954 A.

The Distinction Between the Liberal and the Technical in Education. Percy Hughes. Discusses these two tendencies of modern education, the causes of seeming opposition, the influences that have affected education, the evils and causes and their remedy. 3000 w. Pop Sci M—Oct., 1910. No. 17581 C.

Discussion on "Education for Leadership in Electrical Engineering," New York, April 15, 1910. Samuel Sheldon's paper is discussed. 4500 w. Pro Am Inst of Elec Engrs—Sept., 1910. No. 17342 F.

The Mining School at Bochum, Westphalia. Prof. Henry Louis. Read before the Inst. of Min. Engrs. A descriptive account of this well-known mining school. 3500 w. Ir & Coal Trds Rev—Sept. 16, 1910. No. 17445 A.

Training Engineers at Franklin Union. F. L. Johnson. Illustrated description of laboratory equipment and outline of courses. 3000 w. Power—Sept. 6, 1910. No. 16932.

Exhibitions.

The Technology of Exhibitions (Zur Technik des Ausstellungswesens). J. Kollmann. Draws conclusions on planning and management from the Brussels exposition. 6500 w. Tech u Wirt—Aug., 1910. No. 17500 D.

The Buenos Ayres Exhibition. First of a series of articles describing this International exhibition and exhibits, and giving trade statistics. 2500 w. Engr, Lond—Aug. 26, 1910. Serial. 1st part. No. 16968 A.

The Brussels International Exhibition. J. O. Newman. An illustrated review of the engineering exhibits. 4500 w. Cassier's Mag—Sept., 1910. No. 17161 B.

The Destruction of the Brussels Exposition. Illustrations suggesting its extent, with explanatory comment. 250 w. Engineering Magazine—Oct., 1910. No. 17549 B.

Inventions.

The Modern Profession of Inventing. Joseph B. Baker. Remarks on the passing of the solitary inventor and the appearance of organized professional and team work. 2500 w. Am Mach—Vol. 33. No. 36. No. 17036.

Labor.

Organized Labor's Attitude Toward Machinery. Paul Klapper. A study of trade unions' attitude toward the introduction of new mechanical devices and improvements. 5000 w. Jour of Acc—Sept., 1910—Serial. 1st part. No. 17139 C.

Labor Insurance.

A New Benefit and Pension System. Explains Cheney Brothers' plan for the insurance of employees against sickness, accident and the disability of old age. 1500 w. Ir Age—Sept. 1, 1910. No. 16833 C.

Private Labor-Insurance Companies in Germany (Zur Pensionsversicherung der Privatbeamten). W. Hellmich. Discusses private enterprise in labor pensions and insurance in Germany. 2500 w. Tech u Wirt—Aug., 1910. No. 17502 D.

Management.

Systematic Foundry Operation and Foundry Costs. C. E. Knoeppel. This first of a series of articles discusses the two great forces involved in manufacturing. 3000 w. Engineering Magazine—Oct., 1910. Serial. 1st part. No. 17551 B.

The Twelve Principles of Efficiency. Harrington Emerson. This fifth article of a series discusses the third principle—competent counsel. 2500 w. Engineering Magazine—Oct., 1910. No. 17553 B.

How a Foreman Can Promote Shop Efficiency. Articles submitted in the competition on this subject. Deals principally with handling locomotives at terminals, the value of harmony among workers, and the need of keeping up-to-date in regard to methods. 5500 w. Ry Age Gaz—Sept. 2, 1910. No. 16862.

Natural Resources.

Address before the National Conservation Congress. William H. Taft. Discusses what has been done in respect to agricultural, mineral, forest, coal, oil and gas, and phosphate lands, the laws governing them, and changes proposed. 10000 w. Pop Sci M—Oct., 1910. No. 17580 C.

Patents.

Improvements in Patented Inventions. Editorial discussion of what constitutes an improvement, and to whom the improvement belongs. 1500 w. Engng—Sept. 2, 1910. No. 17094 A.

Invention and Design in Relation to Patents. Editorial discussion of complications in the patent situation. 3000 w. Eng News—Sept. 1, 1910. No. 16851.

The Status of Process Inventions. E. D. Sewall. Discusses the prejudice against process patents, giving opinions in England and the United States, and explaining the philosophy of process inventions. 6500 w. Mach, N Y—Sept., 1910. No. 16804 C.

Wage Systems.

Economy of the Piece Work System in Handling Supplies. D. C. Curtis. Brief general discussion of the piece work system, and of its application to the handling of supplies. 2500 w. Pro St Louis Ry Club—Aug. 12, 1910. No. 16853.

MARINE AND NAVAL ENGINEERING.

Barges.

Barges and Their Resistance to Traction (Matériel de la Batellerie et Essais de Résistance à la Traction). Ch. Lavaud. A study of French canal boats, with results of resistance tests. Ills. 1300 w. Mem Soc Ing Civ de France—July, 1910. No. 17200 G.

See also Motor Barges, under MARINE AND NAVAL ENGINEERING.

Battleships.

Battleship Design. Editorial discussion, giving a description of H. M. battleship Neptune. Ills. 2000 w. Engng—Aug. 26, 1910. No. 16964 A.

The United States Battleship North Dakota. Illustrations and descriptions taken from a lecture by C. B. Edwards. 300 w. Jour Am Soc of Mech Engrs—Oct., 1910. No. 17584 F.

Electric Power.

The Present Day Problem of Ship Propulsion. L. McNamee. Examines the special features of a scheme for applying electricity to the propulsion of naval vessels—the Emmet drive. Ills. 2000 w. Pro U S Nav Inst—Sept., 1910. No. 17322 F.

See also Submarines, under MARINE AND NAVAL ENGINEERING.

Gas Engines.

Gas Driven Ships. An account of a gas power tug and it's service on the River Rhine. Ills. 1200 w. Sci Am Sup—Sept. 10, 1910. No. 17021.

Motor Barges.

Motor Barges of the Chesapeake Bay. Stuart Stevens Scott. Illustrates and describes large gasoline boats used for commerce. 2000 w. Marine Rev—Sept., 1910. No. 17128.

Motor Boats.

Large, Sea-Going Motor Yachts (Grosse, seegende Motor-Jachten). Discusses a project for a 100-ton vessel. Ills. 3000 w. Zeitschr d Mit Motorwagen Ver—Aug. 15, 1910. No. 17458 D.

Sailing Vessels.

Old Transatlantic Packet Ships. Francis B. C. Bradlee. Historical review of early transatlantic service, illustrating and describing vessels used from 1835 to 1854. 3000 w. Int Marine Engng—Sept., 1910. No. 16919 C.

Shipbuilding.

The New Regulations of the German Lloyd (Die neuen Bauvorschriften des Germanischen Lloyd). W. Matthaei. An abstract of the new regulations with discussion. 4000 w. Schiffbau—Aug. 24, 1910. No. 17289 D.

Ship Power.

On the Powering of Ships. Sidney Grover Koon. Gives tabulated data and a study of the important points entering into the powering of large ships. 3000 w. Int Marine Engng—Sept., 1910. No. 16917 C.

Ship Resistance.

The Influence of Trim Upon Resistance of Ships. D. W. Taylor. Briefly discusses the reasons why naval achitects regard moderate variations of trim as having little effect upon resistance, and reviews critically a recent paper on "Wasted Horsepower and Economical Trim." 4800 w. Pro U S Nav Inst—Sept., 1910. No. 17321 F.

The Resistance of Power Boats and a Method of Measuring Same. Seth G. Malby. Considers first resistance in general as applied to ships; second, resistance as applied to power boats; and third a method of measuring same. Ills. 5000 w. Rudder—Sept., 1910. Serial. 1st part. No. 16912 C.

See also Barges, under MARINE AND NAVAL ENGINEERING.

Ships' Boats.

The Boat Problem. Sidney F. Walker. Discusses boats required for men-of-war, and for both passenger and cargo vessels of the mercantile marine. 3000 w. Int Marine Engng—Sept., 1910. No. 16916 C.

Ship Stability.

Stability Models and Tables. Arthur R. Liddell. Discusses methods of illustrating the righting tendency of a vessel when careened under various conditions of draught and stowage. Ills. 2500 w. Engr, Lond—Aug. 26, 1910. No. 16969 A.

Ship Turning.

The Turning Power of Ships (Zur Theorie der Drehkreisbestimmung von Schiffen). Herr Rothe. Mathematical. Ills. 4500 w. Schiffbau—Aug. 10, 1910. No. 17288 D.

Ship Windows.

Scuttles and Sliding Windows for Ships. Illustrates and describes new designs. 1200 w. Engng—Aug. 26, 1910. No. 16967 A.

Steamboats.

The Passing of the Paddle Steamer. Remarks on the effect of the Parsons turbine, and reviewing some of the more famous vessels and their service. 1500 w. Engr, Lond—Sept. 16, 1910. No. 17440 A.

A New Lake Passenger Steamer. Illustrated detailed description of the new steel steamer Alabama, for service on the Great Lakes. 1700 w. Int Marine Engng—Sept., 1910. No. 16918 C.

The New Steamers of the Hamburg Steamboat Company (Die neuen Dampfer der H. D. A. G., Hamburg). Carl Fischer and Willy Sievert. Brief description. Ills. 1000 w. Schiffbau—Aug. 24, 1910. No. 17290 D.

Steam Boilers.

Marine Boiler Construction. John Green. Considers particularly the wet-bottomed cylindrical boiler with return tubes, made for pressures up to 225 pounds per square inch, and gives synopsis of boiler-construction regulations. 5000 w. Boiler Maker—Sept., 1910. No. 17070.

Steamships.

Mine-Laying and Torpedo Regulation Vessel for Portugal. Illustrated description of a small twin-screw steamer designed for laying submarine mines and testing and regulating Whitehead torpedoes. 4000 w. Engng—Sept. 9, 1910. No. 17304 A.

The Channel Steamers "Jan Breydel" and "Pieter de Coninck" in the Ostend-Dover Service (Les Paquebots "Jan Breydel" and "Pieter de Coninck" de la Ligne Ostende-Douvres). Brief description, with plate. Ills. 1600 w. Génie Civil—Aug. 6, 1910. No. 17232 D.

Steam Turbines.

The Impulse and Reaction Turbine for Marine Purposes. J. C. Shaw. A contribution to the discussion of the turbines in the U. S. scout cruisers, Salem and Chester, and their performance. 1000 w. Engr, Lond—Sept. 2, 1910. No. 17095 A.

Late Developments in Steam-Turbine Marine Propulsion (Die Weiterentwickelung des Dampfturbinenbaues für Schiffsantriebswecke). C. Schaffrau. Discusses recently developed transmission systems, etc. Ills. 3800 w. Schiffbau—July 27, 1910. No. 16595 D.

See also Steamboats, under MARINE AND NAVAL ENGINEERING.

Submarines.

The New United States Submarine Boat "Salmon." Waldon Fawcett. Illustrated article describing the electrical equipment. 1200 w. Elec Rev, N Y—Sept. 17, 1910. No. 17169.

The Electrical Propulsion of French Submarines. J. Breguet. Abstract translation from *La Lumière Electrique.* Notes on the electrical equipment of the latest French submarines, showing conditions and difficulties. 3000 w. Elect'n, Lond—Aug. 26, 1910. No. 16946 A.

French Submarines and Submersibles. Abstract translation of an article by M. Laubeuf, in the *Bul. of la Soc. des Ing. Civ de France,* discussing the present position of the construction of submarines and submersibles, particularly in France. 1500 w. Engr, Lond—Aug. 26, 1910. No. 16971 A.

Stability and Strength in Submarine Design (Stabilität und Festigkeit für ein Unterseeboot-Rohprojekt). K. Dietze. Discusses these factors in the design of submarines. Ills. 2000 w. Schiffbau—July 13, 1910. No. 16594 D.

Torpedoes.

The Aerial Torpedo. Johannes Engel. Reviews earlier aerial devices for carrying explosives, and gives an illustrated description of Unge's aerial torpedoes. 1600 w. Sci Am Sup—Oct. 1, 1910. No. 17539.

MECHANICAL ENGINEERING.

AUTOMOBILES.

Brakes.

Modern Motor Car Brakes. F. E. Watts. Discusses what they should do. 1200 w. Horseless Age—Sept. 21, 1910. Serial. 1st part. No. 17415.

Cabs.

Changes in the Berlin Cab Ordinances (Aenderung der Berliner Droschkenordnung). Gives the text of the new regulations. 5000 w. Zeitschr d Mit Motorwagen Ver—Aug. 31, 1910. No. 17460 D.

Cadillac.

The 1911 Cadillac. Illustrates and describes changes and improvements introduced. 1200 w. Auto Jour—Sept. 17, 1910. No. 17418 A.

Carburetors.

Recent Tendencies in Carburetor Construction. Albert L. Clough. Discusses what is being done to adapt carburetors to the changes in the character of gasoline available and to render them more efficient generally. 2000 w. Horseless Age—Aug. 31, 1910. No. 16895.

Carbureters vs. Steam Boilers. Discusses relations of carbureters to internal combustion motors; how they take the place of steam boilers. Ills. 2000 w. Automobile—Sept. 1, 1910. No. 16889.

Kerosene Carburetors. George M. Holley. Illustrates and describes a new design, explaining principles involved. 2000 w. Horseless Age—Sept. 28, 1910. No. 17566.

G. & A. Carbureter. Illustrated description of an automatic French design based on the principle of the Venturi tube. 2000 w. Automobile—Sept. 22, 1910. No. 17382.

Kingston Carbureter. Illustrated detailed description, explaining the requirements and methods of satisfying them. 2800 w. Automobile—Sept. 22, 1910. No. 17381.

Columbia.

Columbia Is Ready. Illustrated description of "Mark 85," one of the latest models. 1800 w. Automobile—Sept. 1, 1910. No. 16888.

Commercial Vehicles.

Commercial Applications. Samuel Woods. Illustrates and describes types of power vehicles for service of a large New York department store. Also the garage. 1500 w. Horseless Age—Sept. 14, 1910. No. 17144.

Left-Side Control for Commercial Vehicles. Morris A. Hall. Discusses the mechanical and operative advantages from the location of the driver's position on the passing side of a machine. 3000 w. Com Veh—Sept., 1910. Serial. 1st part. No. 16868 C.

Motor Trucks for Foundries (Verwendung von Motorlastwagen im Giessereigewerbe). Th. Wolff. Discusses their applications and economy. Serial. 1st part. 1500 w. Giesserei-Zeit—Aug. 15, 1910. No. 17274 D.

Construction.

Some Examples of Present Steel Work in Automobile Construction. J. Coapman. Illustrates and describes a number of adaptations. 1000 w. Horseless Age—Sept. 28, 1910. No. 17567.

Control.

Uniformity of Control. An illustrated discussion of improvements desirable. 1500 w. Auto Jour—Aug. 27, 1910. No. 16940 A.

Garages.

Inexpensive Portable Garage. Describes a fireproof garage that need not cost over $35. Ills. 1500 w. Automobile—Sept. 8, 1910. No. 17008.

Ignition.

Good Service from Dry Cells. James S. Madison. Explains how a satisfactory ignition system may be provided without a magneto. 1700 w. Automobile—Sept. 8, 1910. No. 17009.

Mercedes.

The Mercedes "Fifteen." Views and description of special details in the construction. 1200 w. Auto Jour—Sept. 10, 1910. No. 17186 A.

Motor Lubrication.

New Ideas in Motor Lubrication. C. S. Pelton. Describes a filter to be used with any splash or circulating system. Ills. 1200 w. Horseless Age—Sept. 28, 1910. No. 17568.

Motors.

Automobile Engine Proportions. A. G. Kessler and G. W. Lewis. First of a series of four articles based on the average practice of the best manufacturers in the United States. 4500 w. Am Mach—Vol. 33. No. 37. Serial. 1st part. No. 17117.

The 17-H. P. Mandslay Engine. Illustrated description of the engine and chassis. 700 w. Auto Jour—Sept. 3, 1910. No. 17074 A.

Motor Stroke.

A Résumé of the Long and Short Stroke Discussion. Albert L. Clough. Opinions and statistics showing the trend in practice in the United States during the past four years. 3000 w. Horseless Age—Sept. 21, 1910. No. 17414.

Long Stroke vs. Short Stroke Motor. Henri Feron. Trans. from *La Locomotive*. Shows that the proportion of stroke to bore should be governed by the size of the motor and the service for which it is intended. 2000 w. Horseless Age—Aug. 31, 1910. No. 16894.

Motor Testing.

A Dynamometric Brake for High-Speed Motor Testing (Sopra un Freno dinamometrico per Motori veloci). G. Cicali. Describes a device adapted to the testing of automobile motors. Ills. 1500 w. Industria—Aug. 14, 1910. No. 17243 D.

See also Dynamometers, under MEASUREMENT.

Noises.

Silence. Considers points of construction which prevent the entire absence of noise. 1800 w. Autocar—Aug. 27, 1910. No. 16939 A.

Overland.

Overlands for 1911. Illustrates and describes new models and improvements. 4500 w. Automobile—Sept. 22, 1910. No. 17383.

Racing Cars.

Modern Racing Car Construction. Illustrates and describes the Benz "Prince Henry" model. 800 w. Auto Jour—Aug. 27, 1910. No. 16941 A.

Speedometers.

The "A. T." Illustrated description of an accurate magnetic speedometer. 1000 w. Auto Jour—Sept. 17, 1910. No. 17419 A.

Standardization.

Standardization. Robert W. A. Brewer and F. G. Woollard. Notes on details that could well be standardized to the advantage of manufacturers and users. 1700 w. Autocar—Sept. 3, 1910. No. 17073 A.

Stoddard-Dayton.

Stoddard-Dayton for 1911. Calls attention to improvements introduced and illustrates and describes models. 2500 w. Automobile—Sept. 15, 1910. No. 17121.

Tires.

A Day with the Tire Makers. An illustrated review of the interesting processes, from the gathering of materials to the testing of the finished tires. 2200 w. Automobile—Sept. 15, 1910. No. 17120.

The Pros and Cons of Re-treading. Discusses when it is worth while to have tires re-treaded, and the kinds of injury liable to occur. Ills. 1800 w. Auto Jour—Sept. 17, 1910. No. 17417 A.

Transmissions.

Power Transmission Between Motor and Wheel (Die Bewegungsübertragung vom Motor auf die Automobilräder). Julius Küster. A discussion of various types of automobile transmissions. Ills. Serial. 1st part. 2200 w. Zeitschr d Mit Motorwagen Ver—Aug. 15, 1910. No. 17459 D.

COMBUSTION MOTORS.

Gas Engine Failures.

The Failure of Gas Engine Crank Shafts. Michael Longridge. Illustrated report on the large number of failures due to weakness of this part. 2000 w. Mech Engr—Sept. 2, 1910. No. 17085 A.

Gas Engine Operation.

Recent Experiences in Working Large Gas Engines. Prof. Langer. Abstract of paper read before the Düsseldorf Cong. Gives diagram showing the relative development in Europe of 2-cycle and 4-cycle gas engines, and discusses defects of construction and difficulties experienced. Ills. 2000 w. Ir & Coal Trds Rev—Aug. 26, 1910. No. 16988 A.

Gas Engines.

Notes on the Constructional Details of Gas Engines. Mathematical. 1200 w. Mech Wld—Sept. 16, 1910. Serial. 1st part. No. 17426 A.

The Explosive Properties of Gaseous Mixtures. (Las Mezclas gaseosas detonantes consideradas como Explosivos). Carlos Barutell. A discussion of the phenomena of explosion in gas-engine cylinders. 2500 w. Energia Elec—Aug. 10, 1910. No. 17249 D.

Gaseous Explosions. Third report of the committee appointed for the investigation of gaseous explosions, with special reference to temperature, presented before the Engng. Soc. of the British Assn. for the Adv. of Science. 6000 w. Mech Engr—Sept. 9, 1910. Serial. 1st part. No. 17191 A.

Air-Supply to Gas-Engines. W. E. Dalby. Read before Sec. G. of the British Assn. Experimental study describing method of direct measurement of the air supply by means of an orifice and the calibration of the orifice. 2500 w. Engng—Sept. 9, 1910. No. 17308 A.

Gas Engines for Driving Alternating-Current Generators. Discussion of H. G. Reists' paper. 900 w. Jour Am Soc of Mech Engrs—Sept., 1910. No. 16817 F.

Gas-Engine Generating Sets (Groupes électrogenes avec Moteur à Gaz pauvre). J. A. Montpellier. Describes the Cazes high-speed gas engine and producer for small generating units. Ills. 1500 w. L'Elecn—Aug. 13, 1910. No. 17226 D.

See also same title, under MARINE AND NAVAL ENGINEERING.

Gas Engine Troubles.

Knocking in Gas Engines. Hints which may help in the location and remedy of such troubles. 1200 w. Mech Wld—Sept. 16, 1910. No. 17425 A.

Gasoline Engines.

See Motor Cars, under RAILWAY ENGINEERING, MOTIVE POWER AND EQUIPMENT.

Gas Power Plants.

Operating Experiences with a Blast Furnace Gas Power Plant. Discussion of Heinrich J. Freyn's paper. Also appendix 6, an addition to this paper. Ills. 12000 w. Jour Am Soc of Mech Engrs—Sept., 1910. No. 16820 F.

The Modern Producer Gas Engine Plant. D. D. Faris. Discusses some of the recent developments and future possiblities of such plants. Also general discussion. 5500 w. So & S W Ry Club—July, 1910. No. 17324 D.

Utilizing Waste Heat from Gas Engine Plants. John T. Faig. Abstract of a paper read before the Nat. Gas and Gasoline Engine Trades Assn. Brief suggestions for the utilization of jacket-water and exhaust gases. Ills. 1000 w. Mech Engr—Sept. 9, 1910. No. 17190 A.

Gas Turbine Governing.

The Governing of Gas Turbines (Ueber die Regelung der Gasturbinen). W. Gentsch. The first part of the serial discusses the operation of the gas turbine. Ills. Serial. 1st part. 1000 w. Die Turbine—Aug. 5, 1910. No. 17299 D.

Oil Engines.

The Diesel Oil Engine for Marine Work. Peter Stobie. Read before the Greenock Assn. of Engrs. & Shipbuilders. Describes applications of the Diesel engines and the types used. 2000 w. Mech Wld—Aug. 26, 1910. No. 16958 A.

Fuel Injecting Apparatus for Internal Combustion Engines. Illustrates and describes a design of fuel-injecting apparatus for two-cycle internal combustion engines of the Diesel type. 800 w. Mech Engr—Sept. 16, 1910. No. 17423 A.

HEATING AND COOLING.

Air Cooling.

Cooling Buildings by a New Method of Construction. Illustrated detailed description of the method known as the Fellowes system. 1000 w. Heat & Vent Mag—Sept., 1910. No. 17328.

Air Filtration.

The Richet Air Filter (L'Aérofiltre Richet). A Moreau. Brief illustrated description. 1200 w. Bul Soc d'Encour—July, 1910. No. 17214 G.

Refrigeration.

Elements of Compression System. F. E. Matthews. Illustrated explanation of the principles of operation of this and other systems. 3200 w. Power—Sept. 6, 1910. No. 16935.

Operation of Compression System. F. E. Matthews. Explains the cycle of operation. Ills. 1500 w. Power—Sept. 20, 1910. No. 17318.

Boston Terminal Refrigerating Company's Plant. Illustrated description of the new cold storage warehouse. 1200 w. Ice & Refrig—Sept., 1910. No. 16930 C.

A New Ice Factory in Chicago. General description and views of a 150-ton ice-making plant. 1500 w. Ice & Refrig—Sept., 1910. No. 16931 C.

Leblanc New Refrigerating Process. Illustrated description of a new machine adopted by the French Navy. 1400 w. Sci Am Sup—Oct. 1, 1910. No. 17538.

Steam Heating.

Gravity Steam Heating of a Hospital. Charles L. Hubbard. Heating and ventilating cottage hospitals and the preparation of the apparatus. 1600 w. Met Work—Sept. 17, 1910. No. 17142.

HYDRAULIC MACHINERY.

Centrifugal Pumps.

Design of Centrifugal Pumps. A. Borsody. Influence of the design of the impeller upon the general characteristics, giving formulas and rules to aid the designer. Ills. 200 w. Am Mach—Vol. 33. No. 38. Serial. 1st part. No. 17394.

Turbine Pump Characteristics. Frederick Ray. An illustrated explanation and discussion of the relations of head, power and efficiency to the output of a turbine pump. 4000 w. Am Mach—Vol. 33. No. 36. No. 17034.

Twinvolute Turbine Pumps. Illustrates and describes types suitable for all kinds of service. 1800 w. Ir Age—Sept. 22, 1910. No. 17356.

Electric Pumping.

Automatic Starting and Regulating Devices for Pump and Compressor Motors

(Ueber selbsttätige Anlass- und Reguliervorrichtungen für Pumpen- und Kompressormotoren). Ludwig Weil. Describes their theory and various types. Ills. Serial. 1st part. 2700 w. Elektrotech u Maschinenbau—Aug. 21, 1910. No. 17487 D.

Gas Pump.

The Humphrey Internal Combustion Pump. Illustrated description of an interesting exhibit at the Brussels Exposition. 1700 w. Ir Age—Sept. 15, 1910. No. 17130.

Presses.

See Packings, under MATERIALS OF CONSTRUCTION.

Pumping Plants.

Pumping Plant for the Trustees of the Bombay Port Trust. Plate and description of the plant to be used for pumping out the Hughes Dry Dock. 800 w. Engng —Sept. 16, 1910. No. 17437 A.

See also Water Towers, under RAILWAY ENGINEERING, PERMANENT WAY AND BUILDINGS.

Pumps.

See Engines, under STEAM ENGINEERING.

Pump Valves.

A New Pump Valve (Una nuova Valvola per Pompe). H. Rissmann. Describes the new valve of the Balcke Machine Company, Bochum. Ills. Serial. 1st part. 1300 w. Industria—Aug. 28, 1910. No. 17244 D.

Turbine Tests.

An Investigation of Pressure Distribution in Reaction-Turbine Buckets (Versuche über die Druckverteilung in den Laufzellen arbeitender Reaktionsturbinen). A. Pfarr. Detailed data of the tests and results. Ills. Serial. 1st part. 3800 w. Zeitschr d Ver Deutscher Ing—Aug. 27, 1910. No. 17499 D.

Turbine Theory.

The Fundamentals of Turbine Theory. (Die Grundlagen der Turbinentheorie). Georg Popper. Mathematical discussion of hydraulic-turbine theory. 2700 w. Zeitschr f d Gesamte Turbinenwesen—Aug. 20, 1910. No. 17451 D.

MACHINE ELEMENTS AND DESIGN.

Clutches.

Experimental Analysis of a Friction Clutch Coupling. Discussion of William T. Magruder's paper. 1700 w. Jour Am Soc of Mech Engrs—Oct., 1910. No. 17587 F.

Connecting Rods.

A Graphical Method for Calculating Stresses in a Connecting Rod. Winslow H. Herschel. Explains method and gives examples of its application. 5000 w. Jour Am Soc of Mech Engrs—Oct., 1910. No. 17585 F.

Cylinders.

The Strength of Guns and Cylinders. C. A. M. Smith. Report of experimental investigations of "Guest's law," showing that certain conditions are followed by certain results. 1800 w. Engng—Sept. 2, 1910. No. 17092 A.

Gears.

Allowable Load and Efficiency of Worm Gearing. A. P. Eltoft. Discusses the relation of load to effort, allowable load, and gives an example illustrating the use of formulas given. Ills. 2500 w. Mach, N Y—Sept., 1910. No. 16811 C.

Direct Solution of Spiral Gear Angles. J. Butterworth. Gives tables that will assist in a direct solution of spiral gear angles, given a fixed center distance and normal pitch. 1000 w. Am Mach—Vol. 33. No. 36. No. 17031.

Influence of Impact on Gears. Charles H. Logue. A suggested modification in the Barth equation as applied to the Lewis formula for the strength of gears. 800 w. Am Mach—Vol. 33. No. 38. No. 17393.

Punch Frames.

The Strength of Cast Iron Punch and Riveter Frames. Discussion of A. L. Jenkins' paper. 6000 w. Jour Am Soc of Mech Engrs—Sept., 1910. No. 16816 F.

Rotating Drums.

The Calculation of Rotating Drums (Die Berechnung rotierender Trommeln). Rudolf Lorenz. An exhaustive mathematical discussion. Ills. 4500 w. Zeitschr d Ver Deutscher Ing—Aug. 20, 1910. No. 17498 D.

MACHINE WORKS AND FOUNDRIES.

Aluminium Founding.

See Cores, under MACHINE WORKS AND FOUNDRIES.

Annealing.

The Annealing of Steel. C. M. Johnson. Discusses why steel is annealed and the results obtained. 2500 w. Am Mach—Vol. 33. No. 38. No. 17395.

Brass Founding.

Molding Brass Axle Bearings for Electric Cars. C. Vickers. Illustrated description of method used in Milwaukee, Wis. 1800 w. Foundry—Sept., 1910. No. 16814.

Finishing and Plating Brass Castings. C. Vickers. Illustrates and describes methods used by the National Cash Register Co. 3500 w. Foundry—Sept., 1910. No. 16813.

The Brass Scrap Pile. Suggestions for judging scrap, testing, etc. 2000 w. Foundry—Sept., 1910. Serial. 1st part. No. 16815.

Case Hardening.

Case Hardening in Vacuum with Pure Carbon (Ueber Zementation im luftleeren Raum mittels reinen Kohlenstoffes). Fritz Weyl. Abstract of a paper read at the Düsseldorf Congress. Describes the method and apparatus and reports results. Ills. 1500 w. Stahl u Eisen—Aug. 17, 1910. No. 17262 D.

Castings.

Chilled Castings (Hartguss). Bernhard Osann. Discusses the methods and difficulties of their production, the nature of the changes produced by chilling, etc. Ills. 2100 w. Stahl u Eisen—Aug. 10, 1910. No. 17256 D.

Cores.

Cores for Aluminum Castings. Walter J. May. Remarks on the trouble with shrinkage in aluminum castings, and report of methods tried by the writer and his success with paper cores. Ills. 1500 w. Mech Wld—Sept. 9, 1910. No. 17192 A.

Past and Present Core Supports (Die Kernstützen in früherer und neuerer Zeit). H. Vetter. A review of progress in this branch of foundry practice. Ills. 2500 w. Stahl u Eisen—Aug. 10, 1910. No. 17258 D.

Cutting Tools.

Economical Tool Dressing and Grinding. John Brandle. Explains correct methods of tool dressing, resulting in economy. 1800 w. Mach, N Y—Sept., 1910. No. 16807 C.

Internal Cutting Tools. Douglas T. Hamilton. Information concerning practice for the Brown & Sharpe automatic screw machine. Ills. 4500 w. Mach, N Y—Sept., 1910. Serial. 1st part. No. 16808 C.

Dies.

Practical Hints for Diemakers. Richard L. Breul. The present number discusses blanking and piercing dies. 1500 w. Mach, N Y—Sept., 1910. Serial. 1st part. No. 16812 C.

Forging.

The Making of Drop Forgings. E. F. Lake. An illustrated discussion of materials and methods and their effects. 2200 w. Am Mach—Vol. 33. No. 38. No. 17392.

Forging Machines.

Forging Machine at the Midland Railway Carriage & Wagon Works, Derby. Illustrated detailed description of a No. 4 Horsfall patented forging machine. 500 w. Engr, Lond—Sept. 2, 1910. No. 17101 A.

Foundries.

Specialty Foundry Designed for Automobile Work. Illustrated description of a multiple-story foundry in Cleveland, O., its equipment, methods, etc. 2200 w. Castings—Sept., 1910. No. 17166.

The Foundry Plants of the R. Ph. Waagner Company, L. & J. Biro, and A. Kurz, Vienna (Die Giessereianlagen der Akt.-Geo. R Ph. Waagner, L. & J. Biro and A. Kurz in Wien). Gustav Simon. Illustrated description of interesting features of these large works. Ills. 4000 w. Stahl u Eisen—Aug. 10, 1910. No. 17255 D.

Foundry Furnaces.

The Electric Furnace. W. S. Gifford. Read before the British Found. Assn. Reviews what has been accomplished in the application of the electric furnace to the making of castings. 1200 w. Mech Engr—Aug. 26, 1910. No. 16956 A.

Foundry Practice.

The Foundry Work on Manifolds, Branch-tees or Headers. F. W. Barrows. Explains the construction of core-boxes, and discusses patternmaking and foundry practices. Ills. 2500 w. Castings—Sept., 1910. No. 17167.

Practical Hints on the Mixing of Irons for Special Castings. From *Foundry Trade Jour.* Suggestions for castings to induce superheated steam, flame and acids. 2000 w. Mech Wld—Aug. 26, 1910. No. 16957 A.

Furnaces.

A Vertical Tempering Furnace at the Arbel Works of the Donai Forges (Four à Tremper vertical des Forges de Douai). Le Ct. Fourgeot. Illustrated description of the heat-treatment plant. 2000 w. Rev de Métal—Aug., 1910. No. 17211 E + F.

Galvanizing.

The Influence of Galvanizing on the Strength of Wire. Information from a paper by Dr. Heinrich Winter, read at the Düsseldorf Congress. Explains tests made and conclusions. 1000 w. Ir Age—Sept. 1, 1910. No. 16834 C.

A New Metal-Coating Process (Un nouveau Procédé de Métallisation). M. Schoop. Describes the Schoop process of applying metallic coatings. Ills. 2500 w. Rev de Métal—Aug., 1910. No. 17210 E + F.

Gear Cutters.

The Robey-Smith Bevel Gear Planer. John M. Lloyd. Illustrated detailed description of an interesting English machine and its operation. 2500 w. Ir Age—Sept. 29, 1910. No. 17560.

Grinding Machines.

New Diamond Grinders. Illustrates and describes four improved lines of grinding and polishing machines, made at Providence, R. I. 1500 w. Ir Age—Sept. 29, 1910. No. 17562.

A Grinding Machine for Finishing the Inside and Outside Bearings of Locomotive Driving Axles (Schleipmaschinen zur Bearbeitung der Innen- und Aussen-Lagerstellen von Lokomotivradsätzen). Illustrated description. 1200 w. Glasers Ann—Aug. 15, 1910. No. 17457 D.

Jigs.

The Principles of Jig Design. R. D. Spinney. Explains the usefulness of jigs and discusses the requirements to be kept in mind in the preparation of a jig, the varieties, etc. Ills. 1500 w. Mech Wld—Sept. 9, 1910. Serial. 1st part. No. 17193 A.

Lathes.

Record Ouput of a Car Wheel Lathe. Illustration of a lathe which wound 33 pairs of 36-in. steel-tired wheels in less than 10 hours. 500 w. Am Engr & R R Jour—Sept., 1910. No. 16924 C.

A Comparison of Lathe Headstock Characteristics. Discussion of Prof. Walter Rautenstrauch's paper. 800 w. Jour Am Soc of Mech Engrs—Oct., 1910. No. 17586 F.

Machine Tools.

Gearing for Machine Tools. Thomas R. Shaw. An illustrated analysis of the all-gear drive. 4000 w. Cassier's Mag—Sept., 1910. No. 17163 B.

Machine Tool Design. W. D. Forbes. Helpful suggestions for designers. Ills. 2000 w. Mach, N Y—Sept., 1910. No. 16805 C.

Machine Stops, Trips, and Reversing Mechanisms. Joseph G. Horner. Illustrates and describes various devices and their applications. 4000 w. Mach, N Y—Sept., 1910. No. 16802 C.

The Drummond-Barreto Universal Machine. Illustrated description of a machine for boring, turning, drilling, screw-cutting, milling and gear-cutting, shown at the Olympia exhibition. 700 w. Engng—Sept. 2, 1910. No. 17093 A.

Molding.

The "Washburne" Clay Riser Lining. Illustrated description of this riser lining and its use. 1200 w. Brass Wld—Sept., 1910. No. 17141.

See also Brass Founding, under MACHINE WORKS AND FOUNDRIES.

Pattern Making.

The Shop Practice of a Patternmaker. W. S. Giele. Deals with materials and methods used in modern practice. 7000 w. Castings—Sept., 1910. No. 17168.

Pipe Drawing.

Seamless Steel Tube Manufacture. J. F. Springer. Illustrates and describes methods, with special reference to the National Tube Co.'s processes. 3000 w. Ir Age—Sept. 15, 1910. No. 17129.

Pneumatic Tools.

Use and Care of Pneumatic Tools. Address of J. H. Simmons before the Ry. Tool Foremen's Assn. The importance of properly cleaning and lubricating them, their abuse, suggestions, etc. 1700 w. Boiler Maker—Sept., 1910. No. 17071.

Polishing.

Emery Wheels. James F. Hobart, in *Blacksmith and Wheelwright*. Describes apparatus for polishing. Directions for making the wheels, mounting, etc. 3000 w. Mech Wld—Sept. 2, 1910. No. 17088 A.

Presses.

A 600-Ton Steel Stamping Press. Illustrated description of a tool for finishing off steel motor car hubs. 800 w. Engr, Lond—Sept. 2, 1910. No. 17100 A.

Sand Blast.

The Sand Blast and Its Uses. René Champly. An illustrated account of its development and applications. 800 w. Sci Am Sup—Sept. 10, 1910. No. 17023.

The Sand Blast in Foundry Operation (Das Sandstrahlgebläse, seine Erfindung und Verwendung in der Giessereipraxis). O. Friedheim. Describes the machines built by Alfred Gutmann, Hamburg. Ills. 1600 w. Giesserei-Zeit—Aug. 15, 1910. No. 17275 D.

Sheet Metal Working.

The Manufacture of Armature-Core Discs (Die Herstellung der Anker- und Segmentbleche zu Elektromotoren und Dynamos). C. Krügener. Describes practice and machinery, particularly the apparatus manufactured by L. Schuler, Göppingen, Germany. Ills. Serial. 1st part. 700 w. Elektrotech Rundschau—Aug. 18, 1910. No. 17474 D.

Shop Appliances.

Clamps and Straps for Holding Work While Machining. H. E. Wood. Illustrations, with explanatory notes. Supplement. 1200 w. Mach, N Y—Sept., 1910. No. 16809 C.

Some Small Tools in a Railroad Shop. Illustrates and describes special tools and fixtures used in the Beech Grove shops of the Big Four R. R. 1200 w. Am Mach—Vol. 33. No. 35. No. 16839.

Shop Design.

Layout for a Small Shop. James F. Hobart. Remarks on the arrangement of machine tools, getting the light where it is most needed, etc. 2500 w. Wood Craft—Sept., 1910. No. 16886.

Shop Practice.

Reducing the Costs of Engine Building by Efficiency Methods. William O. Webber. Gives results, explaining the methods that produced them. 2000 w. Engineering Magazine—Oct., 1910. No. 17555 B.

Making Transformer Cases. Illustrates and describes apparatus and methods employed by the Gen. Elec. Co., Pittsfield, Mass. 700 w. Am Mach—Vol. 33. No. 35. No. 16837.

Milling and Drilling Operations on the Ellis Adding Typewriter. Ralph E. Flanders. Illustrates and describes shop practice at the factory in Newark, N. J. 3500 w. Mach, N Y—Sept., 1910. Serial. 1st part. No. 16806 C.

Shop Kinks. Illustrated descriptions of shop practice and appliances in various railroad shops. 7500 w. Ry Age Gaz—Sept. 2, 1910. No. 16861.

Shops.

Sirocco Engineering Works, Belfast. Illustrated description of a new foundry recently put in operation, with information concerning the Sirocco Works generally. 1500 w. Engr, Lond—Aug. 26, 1910. No. 16974 A.

See also same title, under RAILWAY ENGINEERING, MOTIVE POWER AND EQUIPMENT.

Shop Ventilation.

The Removal of Benzine Vapors in Rubber Factories (L'Enlèvement des Vapeurs de Benzine dans les Usines de Caoutchouc). Describes various devices for removing fumes in industrial plants. Ills. 2500 w. Génie Civil—Aug. 20, 1910. No. 17236 D.

Spring Making.

Machine for Making Spiral Springs. Frank S. Bunker. General description of an interesting piece of apparatus. 1200 w. Am Mach—Vol. 33. No. 38. No. 17396.

Taps.

Taps and Die Stocks (Note sur les Tarauds et Filières). A. Minne. Discusses difficulties and requirements and describes a new type of tap. Ills. 1500 w. Mem Soc Ing Civ de France—July, 1910. No. 17201 G.

Tempering.

Hardening Room with New Features. E. F. Lake. Illustrated description of a hardening room at Flint, Mich., specially designed and equipped for automobile work. 2500 w. Am Mach—Vol. 23. No. 36. No. 17030.

Steel and Steel Hardening (Stahl und Stahlhärtung). Describes a number of European hardening ovens. Ills. Serial. 1st part. 2000 w. Zeitschr f Werkzeug—Aug. 5, 1910. No. 17461 D.

See also Furnaces, under MACHINE WORKS AND FOUNDRIES.

Tool Rooms.

Special Tool-Room Appliances in a Railroad Shop. Ralph E. Flanders. Illustrates and describes tools and devices used at the Juniata Shops at Altoona, Pa. 1600 w. Mach, N Y—Sept., 1910. No. 16803 C.

See also Cutting Tools, under MACHINE WORKS AND FOUNDRIES.

Welding.

Oxy-Acetylene Welding, Apparatus. E. F. Lake. Discusses the process and the inventions that make it possible, and its application. 4000 w. Am Mach—Vol. 33. No. 36. Serial. 1st part. No. 17032.

MATERIALS OF CONSTRUCTION.

Alloys.

Light Alloys for Aeronautical Purposes. W. Rosenhain. From the report of the Adv. Com. for Aeronautics for the year 1909-10. Describes and compares these alloys and states conclusions. 2500 w. Mech Engr—Sept., 1910. No. 17424 A.

Alloy Steels.

Cupro-Nickel Steel. G. H. Clamer. Extracts from a paper read at recent meeting of Am. Soc. for Test. Mat. Reviews recent work on the properties and constitution of alloys, and reports tests and conclusions. Discussion by Dr. John A. Matthews. 2500 w. Met & Chem Engng—Sept., 1910. No. 16874 C.

Vanadium and Metallurgy. J. Kent Smith and W. L. Turner. Briefly considers some of the ways in which vanadium acts upon steel, as introductory to detailed descriptions of the commercial types of vanadium steels now in use. 1500 w. Ir & Coal Trds Rev—Sept. 9, 1910. Serial. 1st part. No. 17314 A.

Breakages.

The Study of Breakages. J. C. W. Humfrey. Gives a brief account of the more frequent causes of failure, and a general description of the manner of investigating at the Nat. Phys. Laboratory, with details of a number of cases. 29 illustrations. 9500 w. Jour W of Scotland Ir & St Inst—March-April, 1910. No. 17325 N.

Cast Iron.

The Effect of Sulphur and Silicon on Cast Iron. J. E. Stead. Presidential address at Sheffield, before the British Assn. Discusses the effect of these substances on the carbon condition of commercial cast iron. Ills. 7500 w. Nature—Sept. 8, 1910. No. 17185 A.

The Relation Between the Elasticity of Cast Iron Under Bending Stress and Its Elasticity Under Tension and Compression (Zusammenhang der Biegungselastizität des Gusseisens mit seiner Zug- und Druckelastizität). A. Herbert. A report and discussion of elaborate tests. Ills. Serial. 1st part. 4400 w. Zeitschr d Ver Deutscher Ing—Aug. 20, 1910. No. 17496 D.

Heat Insulation.

Testing of Heat Insulating Materials. F. Bacon. Describes apparatus for calculating the loss of heat in heat-insulating materials, and gives particulars of tests on a number of materials, and also the effect of an air jacket. 2000 w. Elect'n, Lond—Sept. 16, 1910. No. 17430 A.

Conductivity of Heat-Insulation and Structural Materials (Wärmeleitfähigkeit von Isolier- und Baustoffen). Heinrich Gröber. Reports results of tests at the Munich Technical Highschool. 4000 w. Zeitschr d Ver Deutscher Ing—Aug. 6, 1910. No. 17491 D.

Metallography.

Apparatus for Microscopic Examination of Metals. Albert Sanveur. An illustrated discussion of the methods and equipment required in metallographical research. 3500 w. Ir Trd Rev—Sept. 8, 1910. Serial. 1st part. No. 17007.

Packings.

Packings for Hydraulic Presses. A. Lewis Jenkins. Illustrates and describes different kinds used, discussing their efficiency. 3000 w. Am Mach—Vol. 33. No. 38. No. 17397.

Steel.

The Gases Occluded in Steel (Ueber die Gase aus technischen Eisensorten). P. Goerens. Describes apparatus used in making tests and reports results. Ills. 2800 w. Stahl u Eisen—Aug. 31, 1910. No. 17270 D.

Tool Steel.

Cutting Properties of Tool Steel. Edward G. Herbert. A report of tests and practical information obtained from them. 3000 w. Am Mach—Vol. 33. No. 36. Serial. 1st part. No. 17035.

MEASUREMENT.

Accelerometer.

On the Use of an Accelerometer in the Measurement of Road Resistance and Horse-Power. H. E. Wimperis. Illustrates and describes the construction and principle of an accelerometer designed by the author, giving results of tests. 2000 w. Elect'n, Lond—Sept. 16, 1910. No. 17433 A.

Calipers.

Automatic Micrometer Calipers. Illustrated description of a series of automatic calipers made in England. 1500 w. Mech Engr—Aug. 26, 1910. No. 16955 A.

Calorimetry.

Determining the Heat Value of Coal (Heizwertbestimmungen von Kohlen). A. Brüser. The first part describes a bomb calorimeter devised by the author. Ills. Serial. 1st part. 1000 w. Elektrotech Rundschau—Aug. 25, 1910. No. 17476 D.

Dynamometers.

The Cradle Dynamometer for Testing Electrical Machinery. J. Davis and F. Shaw. Abstract of a paper read before the Manchester Sec. of the Inst. of Elec. Engrs. Illustrated description of the instrument and its use, giving experiments and results. 2000 w. Mech Engr—Sept. 2, 1910. No. 17084 A.

A. C. A.'s New Engine Testing Dynamometer. Joseph B. Baker. Illustrated description of a machine for testing automobile, motor boat, and aeroplane engines. 2200 w. Horseless Age—Sept. 14, 1910. No. 17143.

A Dynametric Plow for Determining Some Physico-Mechanical Characteristics of Earth (Di un nuovo Coltro dinamometrico per la Determinazione di alcune Caratteristiche fisico-meccaniche del Terreno). Federigo Giordano. Describes the device and its use. Ills. Serial. 1st part. 1000 w. Industria—Aug. 14, 1910. No. 17242 D.

Efficiencies.

A Comparison of Efficiencies. G. A. Glick. Defines mechanical and thermal efficiencies, and explains how they are obtained for various types of machines. 1500 w. Power—Sept. 13, 1910. No. 17056.

Gas Meters.

Measurement of Quantities of Gas by Means of Diaphragms (Mesure des Quantités de Gaz au Moyen de Diaphragmes). Otto Muller. A complete theoretical and practical discussion of the method, based on extended experiments. Ills. 10000 w. Rev de Métal—Aug., 1910. No. 17213 E + F.

Hardness

Present Position of Hardness Testing (Der Heutige Stand der Härteprufung). A Reichelt. A review of methods and apparatus. Ills. 2100 w. Giesserei-Zeit—Aug. 1, 1910. No. 17271 D.

Impact Test.

The Impact Test for Cast Iron (Ueber Schlagproben mit Gusseisen). A. Gessner. Reports results of tests and discusses the utility of impact testing. 1500 w. Stahl u Eisen—Aug. 10, 1910. No. 17257 D.

Planimeters.

An Improved Hatchet Planimeter. Frank S. Bunker. Illustrates and describes an improved form in which the plane of the tracing arm is kept constantly at right angles to the surface of the area to be measured. 1200 w. Power—Sept. 20, 1910. No. 17319.

Testing Metals.

Integrity of Tests of Metals. Alexander E. Outerbridge, Jr. Reasons for doubts as to whether such tests may be relied upon with confidence. 2000 w. Jour Fr Inst—Sept., 1910. No. 17336 D.

The Mean Value of Test Results (Der Mittelwert von Festigkeitszahlen). A. Cappilleri. A discussion of methods of obtaining the mean of the results of strength of materials tests. Ills. 3000 w. Aug. 6, 1910. No. 17467 D.

Testing Methods.

Steel Testing by Corrosion (Essais des Aciers par Corrosion). F. Cloup. Describes the value of the corrosion test devised by M. Frémont in detecting piping in steel. Ills. 2000 w. Rev de Métal—Aug., 1910. No. 17212 E + F.

Thermometry.

Thermometer Correction Curves. Frederick Ray. Gives curves showing the corrections to be added for various immersions of the thermometer stem and various temperatures. 700 w. Power—Sept. 27, 1910. No. 17511.

Water.

The Right Angled Triangular Weir. Charles N. Cross. Discusses a type of weir which has proved more satisfactory than the rectangular weir in measuring small quantities of water. 1200 w. Power—Sept. 20, 1910. No. 17320.

POWER AND TRANSMISSION.

Air Compressors.

Hydraulic Compressors (Hydraulische Kompressoren). P. Bernstein. Briefly describes installations in Europe and America. Ills. 1500 w. Glückauf—Aug. 13, 1910. No. 17282 D.

See also Engines, under STEAM ENGINEERING.

Belts.

The Determination of Pulley and Belt Sizes. C. B. Mills. Gives a chart and explains an easy graphic solution of belt problems. 2000 w. Elec Jour—Sept., 1910. No. 16826.

Compressed Air.

The Efficiency of Compressed Air. Snowden B. Redfield. Explains the ratio of the work represented in the compressed air to that done by the compressor. 1000 w. Power—Sept. 13, 1910. No. 17057.

The Production and Utilization of Compressed Air in Germany to the Beginning of 1910 (Die Erzeugung und Verwendung von Druckluft im deutschen Bergbau zu Beginn des Jahres 1910). A. von Ihering. A statistical review of compressed-air practice. 10200 w. Glückauf—Aug. 27, 1910. No. 17286 D.

Compressed Air Hose.

Economical Size of Air Hose. R. D. Gatewood. Explains methods of determining the best size of air hose for pneumatic tools used in a shipbuilding plant. Ills. 900 w. Am Mach—Vol. 33. No. 36. No. 17033.

Specifications for Air Hose. R. D. Gatewood. Explains methods of testing devised to govern the purchase of 50,000 feet of air hose for the Mare Island Navy Yard. 1500 w. Am Mach—Vol. 33. No. 35. No. 16840.

Critical Speeds.

Critical Speed Calculation. S. H. Weaver's paper is discussed. 1200 w. Jour Am Soc of Mech Engrs—Sept., 1910. No. 16821 F.

Electric Driving.

Power Consumption of the Machine Tools at the Readville Shops. Gives results of tests to determine the power required for driving individual and grouped machine tools under light and full load conditions. 1000 w. Am Engr & R R Jour—Sept., 1910. No. 16923 C.

Gearing.

See Machine Tools, under MACHINE WORKS AND FOUNDRIES.

Mechanical Plants.

A modern Combination Utility Plant. Illustrated description of an electric-generating, steam-heating, refrigerating and cold-storage plant at Detroit. 4000 w. Elec Wld—Sept. 1, 1910. No. 16841.

Power Plants.

Metropolitan Home Office Plant. F. L. Johnson. Illustrated description of the power plant equipment of the tallest office building in the world, and some of the leading features of the building. 2200 w. Power—Sept. 20, 1910. No. 17315.

Solar Motors.

The Commercial Solution of the Problem of Utilizing, for the Production of Power, the Energy of Solar Radiation, the Wind and Other Intermittent Natural Sources. R. A. Fessenden. Read before the British Assn. Claims to have solved this problem. Also editorial. 4500 w. Elect'n, Lond—Sept. 16, 1910. No. 17434 A.

Turbo-Compressors.

Testing the Discharge of a Turbo Blower. Michael Longridge. From report for 1909 of the British Engine, Boiler & Elec. Ins. Co., Ltd. Describes tests made as examples of two methods by which large quantities of air at absolute pressures were measured, and to show how the velocities varied. Ills. 1500 w. Mech Engr—Sept. 16, 1910. No. 17422 A.

Novel Air Compressor. Illustrated description of a new mechanical movement, shown at the British Engng. Ex., which can be applied to the motoring field.—The Lamplough rotary air compressor. 1200 w. Automobile—Sept. 29, 1910. No. 17571.

Wind Power.

See Solar Motors, under POWER AND TRANSMISSION.

STEAM ENGINEERING.

Barometric Readings.

Handy Chart for Barometer Readings. G. A. Glick. Gives chart for the conversion of barometric readings, with explanation. 400 w. Power—Sept. 6, 1910. No. 16934.

Boiler Design.

The Application of Graphical Charts to the Solution of Boiler Problems. F. A. Garrett. Explains the principles of graphical charts and their application to various boiler problems. 3000 w. Boiler Maker—Sept., 1910. No. 17069.

Boiler Fittings.

Blow-Off Cocks for Steam Boilers. Charles J. Simeon. Illustrates and describes developments in the design. 1000 w. Power—Sept. 20, 1910. No. 17317.

Boiler Management.

Care and Operation of Steam Boilers. William Westerfield. Discusses proper and improper methods of firing and their influence on combustion, giving some useful hints upon cleaning fires. 1200 w. Power—Sept. 27, 1910. No. 17509.

Boilers.

See Engines, under STEAM ENGINEERING.

Boiler Stoking.

See Smoke Prevention, under STEAM ENGINEERING.

Condensers.

Condensers for Small Central Stations. Harry Pennington. Read before the S.-W. Elec. & Gas Assn. Explains the effect of vacuum on the steam consumption of various types of prime movers, discussing condensation and describes recent improvements in condenser apparatus. Ills. 5000 w. Am Gas Lgt Jour—Sept. 5, 1910. No. 16887.

The Velocity of the Circulating Water in Surface Condensers. R. M. Neilson. Discusses the question of the velocity of the water through the condenser tubes, aiming to show the limits within which the best velocity may be ascertained in any given case. 3000 w. Engr, Lond—Sept. 9, 1910. No. 17311 A.

Automatic Control of Condensing Water. B. Viola. Deals chiefly with condensers for vacuum plants, explaining conditions and describing the construction of the automatic controller. Ills. 2500 w. Jour Am Soc of Mech Engrs—Oct., 1910. No. 17583 F.

Some Experiments with the Regulation of Circulating Water. W. N. Y. King. Describes experiments with circulating water for condensers, giving tabulated results. 800 w. Elec Rev, Lond—Sept. 2, 1910. No. 17077 A.

Engine Compression.

Some Points Favoring Compression. Prof. R. C. Heck. Objects to conclusions unfavorable to compression in an article by Prof. Dwelshauvers-Dery, and claims that compression properly applied is advantageous. Ills. 2500 w. Power—Sept. 13, 1910. No. 17507.

Clearance and Compression. V. Dwelshauvers-Dery. A reply to Prof. Heck's criticism of the author's earlier paper, giving facts which he claims invalidates Prof. Heck's argument. 2800 w. Power—Sept. 27, 1910. No. 17514.

Engine Design.

High Speed Compound Engine Design. J. D. Speedium. First of a series of articles giving illustrated detailed description of present British practice in the design of a 500-h.p. engine. 4000 w. Power—Sept. 27, 1910. No. 17512.

Engine Governing.

Constants in Engine Governing (Die massgebenden Konstanten bei der Regelung der Kraftmaschinen und ihre Wechselbeziehungen). Herr Kröner. Mathematical discussion of the governing of reciprocating engines. Ills. 4800 w. Die Turbine—Aug. 20, 1910. No. 17450 D.

Engine Pistons.

Inequality of Piston Displacement. Guy Wise. Analysis of the problem of unequal piston displacement due to the angularity of the connecting rod. 600 w. Power—Sept. 27, 1910. No. 17510.

Engines.

The Locomobile or Superheated-Steam Unit. Warren H. Miller. An illustrated study of advanced Continental power practice. 3500 w. Engineering Magazine—Oct., 1910. No. 17552 B.

Combination Engine and Boiler. Warren H. Miller. Illustrated description of a German design combining engine, boiler and auxiliaries, having a water consumption of about 10 lbs. per h.p. hour. 1500 w. Power—Sept. 27, 1910. No. 17508.

Locomobiles, Boilers, Pumps, and Compressors at the Brussels Exposition (Lokomobilen, Dampferzeuger, Pumpen und Kompressoren auf der Weltausstellung in Brüssel 1910). Hermann Franke. A preliminary report. 5400 w. Zeitschr d Ver Deutscher Ing—Aug. 6, 1910. No. 17489 D.

Steam Engines and Turbines at the Brussels Exposition (Der Kraftmaschinenbau auf der Weltausstellung in Brüssel 1910). H. Dubbel. A detailed description of the exhibits. Ills. Serial. 1st part. 2700 w. Zeitschr d Ver Deutscher Ing—Aug. 6, 1910. No. 17490 D.

Engine Tests.

Tests of a Compound Superheated-Steam Engine with Live-Steam Intermediate Heating (Versuche an einer mit Zwischenüberhitzung durch Frischdampf arbeitenden Heissdampf - Verbundmaschine). M. F. Gutermuth and Prof. Watzinger. Describes the engine and tests and gives detailed results. Ills. 4200 w. Zeitschr d Ver Deutscher Ing—Aug. 13, 1910. No. 17494 D.

See also Turbine Tests, under STEAM ENGINEERING.

Entropy.

The Physical Meaning of Entropy. A. L. Menzin. Gives definition and applies it to phenomena. 2000 w. Eng News—Sept. 1, 1910. No. 16848.

Exhaust Steam.

See Turbines, under STEAM ENGINEERING.

Mechanical Stokers.

The Underfeed Stoker. Illustrated description of two types made and used in England. 1500 w. Col Guard—Sept. 9, 1910. No. 17302 A.

Rotary Engines.

Recent Developments in Rotary Engines. An illustrated general review of recent types. 6000 w. Eng News—Sept. 15, 1910. No. 17106.

Smoke Prevention.

Smoke Prevention and the Efficiency of Firemen. A Concrete Instance. J. A. Switzer. Illustrates the improvement that followed the application of expert advice. 800 w. Engineering Magazine—Oct., 1910. No. 17554 B.

Stacks.

Some Notes on Power Station Chimneys. E. Kilburn Scott. Gives some general rules for chimney construction, and illustrates and describes types. 3500 w. Ir & Coal Trds Rev—Sept. 2, 1910. No. 17103 A.

Steam Piping.

Operation of the Steam Loop. F. L. Johnson. Illustrated explanation of the principles upon which the action of the steam loop depends. 1500 w. Power—Sept. 13, 1910. No. 17055.

Steam Properties.

Revision of the Steam Laws. Robert H. Smith. Discusses the difficulties of accurate measurement of temperature, and the strong probability of errors in the Steam Tables. 2700 w. Engr, Lond—Aug. 26, 1910. No. 16970 A.

Thermodynamic Units.

Two proposed Units of Power. Discussion of Prof. William T. Magruder's paper. 1800 w. Jour Am Soc of Mech Engrs—Sept., 1910. No. 16819 F.

Turbines.

Steam Turbines for Both High and Low Pressure. Illustrates and describes details of the DeLaval mixed flow type. 2500 w. Ir Age—Sept. 15, 1910. No. 17131.

The Addition of Low-Pressure Turbines to Existing Steam Engines. Brief discussion of the problem from the commercial standpoint. 800 w. Elec Rev, Lond—Sept. 16, 1910. No. 17427 A.

Progress in the Use of Exhaust Steam Power. J. Burns. Abstract of a paper read before the Inst. of Min. Engrs. Considers types of exhaust steam turbines, and their successful applications, especially in collieries and iron and steel works. 7500 w. Ir & Coal Trds Rev—Sept. 16, 1910. No. 17442 A.

Steam Turbines (Turbines à Vapeur). A review of recent turbine literature and patents. Ills. Serial. 1st part. 5000 w. Rev de Mécan—Aug., 1910. No. 17220 E + F.

See also Engines, under STEAM ENGINEERING.

Turbine Tests

Test of a 15,000-KW. Steam-Engine-Turbine Unit. H. G. Stott and R. J. S. Pigott. Explains reasons for adopting this type to furnish additional power for the N. Y. subway, giving a description of the plant and a summary of the results obtained, with tabulated data acquired during tests and general discussion. Ills. 11400 w. Pro Am Inst of Elec Engrs—Sept., 1910. No. 17341 F.

Valve Gears.

Development Releasing Valve Gear. C. A. Tupper. An illustrated review of the development of this type of valve gear from the time of Watt, explaining the operation of each type. 2000 w. Power—Sept. 6, 1910. Serial. 1st part. No. 16933.

Valve Setting.

Setting Valves of a Williams Engine. Hubert E. Collins. Directions for the proper setting of the valves and the governor adjustment, with illustrations. 1500 w. Power—Sept. 20, 1910. No. 17316.

TRANSPORTING AND CONVEYING.

Cableways.

A Timber Transporting Plant in the Transylvanian Alps (Eine Holztransportanlage in den transsylvanischen Alpen). A. Pietrkowski. Describes an important cableway installation. Ills. 2000 w. Schweiz Bau—Aug. 6, 1910. No. 17295 B.

Coal Handling.

Feeding Devices for Coal-Transporting Plants in Boiler Houses (Speiseapparate bei Kohlentransportanlagen in Kesselhäusern). William Jaeger. The first part discusses the general requirements of these devices. Ills. Serial. 1st part. 1000 w. Elektrotech Rundschau—Aug. 25, 1910. No. 17475 D.

Conveyers.

A New Steel Belt Conveyer in Use in Sweden. Alfred Gradenwitz. Illustrated description of a flexible steel ribbon conveyer, reporting low costs. 2000 w. Eng & Min Jour—Sept. 3, 1910. No. 16899.

Dock Machinery.

See Docks, under CIVIL ENGINEERING, WATERWAYS AND HARBORS.

Exhibitions.

Hoisting and Conveying Devices at the Brussels Exposition (Die Hebezeuge und Forderanlagen auf der Weltausstellung in Brussel 1910). Herr Aumund. Describes the exhibits of cranes, conveyers, dredges, hoisting engines, mine locomotives, elevators, etc. Ills. Serial. 1st part. 3000 w. Zeitschr d Ver Deutscher Ing—Aug. 13, 1910. No. 17493 D.

Lifting Magnets.

Lifting Magnets and Their Use in Foundries and Iron Works (Hebemagnete und ihre Anwendung in Giesserei- und Hüttenbetrieben). Herr Wintermeyer. Describes a number of American and European devices and installations. Ills. Serial. 1st part. Giesserei-Zeit—Aug. 1, 1910. No. 17272 D.

Ore Handling.

A New Grab Bucket for Ore and Coal Handling Plants and Contractors' Use. Illustrated description of a bucket invented by H. P. Andresen. 1200 w. Eng News—Sept. 22, 1910. No. 17354.

The Handling and Storage of Iron Ores (Ueber Bewegung und Lagerung von Eisenerzen auf Grubenanlagen). K. Glinz. An illustrated description of methods of handling ore cars and storing ore at iron mines. Serial. 1st part. 4200 w. Stahl u Eisen—Aug. 31, 1910. No. 17268 D.

MISCELLANY.

Aeronautics.

The Work of the Government Aeronautical Committee. A review of work done, and of subjects of aeronautical interest, based on the first annual report of the Advisory Committee for Aeronautics. Ills. 2000 w. Engr, Lond—Sept. 9, 1910. No. 17309 A.

The Aeroplane Industry in France. W. F. Bradley. Brief illustrated review of the development. 1200 w. Mach, N Y—Sept., 1910. No. 16810 C.

Aeroplane Traffic. Marius C. Krarup. A reasoned comparison between aeroplanes, motor boats, bicycles, motor bicycles and automobiles, with regard to the chances for the immediate growth of an aeroplane industry. 2200 w. Automobile—Sept. 15, 1910. Serial. 1st part. No. 17122.

Airships and the Navy. Dr. Robert Grimshaw. Observations on the part that dirigible air craft will play in future conflicts on the ocean. 2800 w. Automobile—Sept. 29, 1910. No, 17572.

The Aeroplane in War. Brief discussion of its possibilities and impossibilities. 1800 w. Sci Am Sup—Sept. 17, 1910. No. 17114.

The Electrical Equipment of an Airship. Frank B. Rae, Jr. A description of the plant for the "America," to furnish a lighting system, telephone system, and wireless outfit. 1000 w. Elec Wld—Sept. 22, 1910. No. 17361.

Proposed Transatlantic Airship Flight. Illustrated detailed description of the Wellman airship, in which a crew of six will attempt to cross the Atlantic. 3000 w. Sci Am—Oct. 1, 1910. No. 17537.

The Essential Problems of Aviation (Les Problèmes essentiels de l'Aviation). Hector Pouleur. An exhaustive summary of the problems of aeroplane design. Ills. Serial. 1st part. 1500 w. All Indus—Aug., 1910. No. 17230 D.

Progress in Aviation. Editorial review of progress during the past year, as shown at the recent international aviation meeting in Great Britain. 2000 w. Engng—Sept. 9, 1910. No. 17305 A.

Limits of Size in Aeroplanes. Editorial discussion of the limits of size and of load. 2500 w. Engng—Sept. 16, 1910. No. 17438 A.

The New Wright Biplane. Illustrates and describes the latest modification in which the front horizontal rudders are removed. 800 w. Sci Am—Sept. 3, 1910. No. 16869.

The Value of Anchored Tests of Aerial Propellers. Walter A. Scoble, and S. C. Carter. Read before the British Assn. An illustrated study. 2000 w. Engng—Sept. 9, 1910. No. 17307 A.

Aerial Propellers and Some Test Results. Charles Edward Larard and Robert Oliphant Boswall. A study of the design, construction, and testing of propellers. Ills. 3000 w. Engng—Sept. 2, 1910. No. 17091 A.

The Chalais-Mendon Aeronautic Laboratory and the Experiments on Aerial Propellers (Le Laboratoire aéronautique de Chalais-Mendon et les Experiences sur les Hélices propulsives). Lt.-Col. G. Espitallier. Describes the equipment and tests, and outlines the results. Ills. 2500 w. Génie Civil—Aug. 27, 1910. No. 17240 D.

Measuring Aeroplane Altitudes. Augustus Post. Explains methods used to determine the altitude reached by Walter R. Brookins, at Atlantic City. 1200 w. Am Mach—Vol. 33. No. 35. No. 16838.

The Movement of Fluids on Surfaces (Remarques sur l'Ecoulement des Fluides le Long des Surfaces). R. Tison. A theory, tested by Rateau's results, applicable to the design of aeroplanes and propellers. Ills. 4500 w. Rev de Mécan—Aug., 1910. No. 17219 E + F.

Agricultural Machinery.

Machinery at the General Agricultural Congress, Paris, June 14-21, 1910 (Les Machines au Concours général agricole de Paris). H. Pillaud. Illustrated description of the exhibits. Serial. 1st part. 3500 w. Tech Mod—Aug., 1910. No. 17224 D.

Exhibitions.

Engineering Exhibition at Olympia. Illustrated description of exhibits in the various departments of engineering. Plate. 4500 w. Engr, Lond—Sept. 9, 1910. Serial. 1st part. No. 17312 A.

The Naval, Mercantile Marine, and General Engineering and Machinery Exhibition, Olympia. Joseph Horner. Begins a description of exhibits of interest. Plate and Ills. 6500 w. Engng—Sept. 9, 1910. Serial. 1st part. No. 17303 A.

Guns.

Balloon Guns and Projectiles. An illustrated description of what is being done in Germany in the manufacture of ordnance for attacking balloons and airships. 1200 w. Engr, Lond—Sept. 16, 1910. No. 17439 A.

Modern Large-Caliber Ordnance (Sui moderni Cannoni di grande Calibro). G. Pecori-Giraldi. A consideration of their construction, difficulties, utility, etc. 6000 w. Riv Marit—July-Aug., 1910. No. 16554 E + F.

Safety Appliances.

The Mechanics of Saving Life. David S. Beyer. An illustrated general description of some of the principal features of safety work as at present developed in the U. S. Steel Corporation. 3500 w. Sci Am Sup—Sept. 10, 1910. Serial. 1st part. No. 17022.

Protective Appliances in Cotton Mills. H. M. Crawford. A fully illustrated article describing methods for reducing accident risks. 3500 w. Cassier's Mag—Oct., 1910. No. 17696 B.

Shoe Machinery.

Machinery in Shoe Making. S. B. Redfield. An illustrated general description of the Goodyear welt process of making shoes, and the ingenious devices used. 3500 w. Am Mach—Vol. 33. No. 31. No. 16162.

Sugar Machinery.

Sugar Cane-Crushing Plant at the Brussels Exhibition. Illustrated description of the exhibit of Messrs. Gebr. Stork & Co., of Hengelo, Holland. 1200 w. Engng—Aug. 12, 1910. No. 16691 A.

Textile Machinery.

Modern Cotton-Mill Efficiency. H. M. Crawford. Illustrates and describes safety appliances in carding, drawing and roving machinery. 3000 w. Cassier's Mag—Sept., 1910. No. 17165 B.

See also Safety Appliances, under MISCELLANY.

MINING AND METALLURGY.

COAL AND COKE.

Accidents.

Coal Mining Fatalities in Belgium. Frederick L. Hoffman. Great care in timbering, ventilating, and hoisting results in low death rate. Explosives are prohibited in all fiery mines. 2200 w. Eng & Min Jour—Sept. 10, 1910. No. 17042.

Analysis.

The Determination of Sulphur in Coke (Zur Bestimmung des Schwefels im Koks). M. Holliger. A description of the barium chromate method, giving results of tests. 2000 w. Stahl u Eisen—Aug. 10, 1910. No. 17259 D.

Austria.

The Steiermark Coal Deposits (Mitteilungen über die steiermärkischen Kohlenvorkommen am Ostfuss der Alpen). B. Granigg. An exhaustive description of this Austrian coalfield. Ills. Serial. 1st part. 3500 w. Oest Zeit f Berg u Hüttenwesen—Aug. 13, 1910. No. 17278 D.

Coal Cutting.

Recent Developments in the Undercutting of Coal by Machinery. Edward W. Parker. Considers the use of mining-machines in bituminous mines, illustrating and describing types. 9500 w. Bul Am Inst of Min Engrs—Sept., 1910. No. 17347 F.

Coal-Cutting by Machinery in India. W. J. Greener. From the *Trans. Min. & Geol. Inst. of India.* Brief paper and discussion. Considers the advantages claimed, and the best motive power. 1600 w. Ir & Coal Trd Rev—Sept. 2, 1910. No. 17102 A.

Coke Oven Gas.

See Electric Power, under COAL AND COKE.

Coke Ovens.

The Elliott-Jones Vertical Coke-Oven. T. Campbell-Futers. Illustrated description. 1500 w. Ir & Coal Trds Rev—Sept. 16, 1910. No. 17443 A.

Recent Developments in Coke-Oven Construction and Progress in the Introduction of Mechanical Operation (Ueber die neuere Entwicklung der Kokerei nach Bauart der Oefen und Ausbildung des Mechanischen Betriebes). Fr. Herbst. Read at the Düsseldorf Congress. An exhaustive record of progress in coking practice. Ills. Serial. 1st part. Stahl u Eisen—Aug. 31, 1910. No. 17267 D.

Coking.

Tarless Coke. Describes a plant for the production of coke from which all the tar-like matter has been removed. The process is the distillation of the coal under a high vacuum. 1500 w. Engr, Lond—Aug. 26, 1910. No. 16975 A.

Electric Power.

Electrical Equipment of the Rose Bridge and Douglas Bank Collieries, Wigan. W. Winsborough. Brief illustrated description, especially the method of preventing leakage, and the protection against shock. 800 w. Elect'n, Lond—Aug. 26, 1910. No. 16950 A.

Electric Power Plants in the Saarbrücken District (Die Kraftwerke der Kgl. Bergwerksdirektion zu Saarbrücken). Herrn Mengelberg and Peucker. Detailed descriptions of plants using coke-oven gas both in gas engines and under boilers. Ills. 21000 w. Glückauf—Aug. 27, 1910. No. 17285 D.

Explosions.

The Prevention of Coaldust Explosions by Zone Systems. E. O. Simcock. Abstract of paper read before the N. Staffordshire Inst of Min. & Mech. Engrs. A discussion of whether there is yet sufficient data available to determine the practical utility of these systems. 4000 w. Col Guard—Sept. 2, 1910. No. 17090 A.

Great Britain.

Geological Research in the Coalfields. Information from the geological survey report for 1909. 3000 w. Col Guard—Aug. 26, 1910. Serial. 1st part. No. 16959 A.

India.

Indian Mining in 1909. Facts from the report of J. R. R. Wilson, H. M. chief inspector of mines in British India, so far as they relate to coal mining. 4000 w. Col Guard—Sept. 9, 1910. Serial. 1st part. No. 17301 A.

Iowa.

Coal Fields of Iowa and Missouri. Henry Hinds. Information concerning the extent of the beds, quantity of coal, prospecting and mining methods. 3500 w. Mines and Min—Sept., 1910. No. 16878 C.

Mexico.

Exploration of Certain Iron-Ore and Coal Deposits in the State of Oaxaca, Mexico. J. L. W. Birkinbine. Describes exploratory work, especially the location of coal-deposits. Also describes the country and customs, geology and general mining and industrial conditions. Ills. 5500 w. Bul Am Inst of Min Engrs—Sept., 1910. No. 17345 F.

Mine Gas.

Barometric Pressure and Liberation of Firedamp. Leon Morin. Abstract translation from *Ann. des Mines.* Experiments indicate that the outflow of gas in a mine is influenced by the variations in atmospheric pressure. 4500 w. Eng & Min Jour—Sept. 17, 1910. No. 17150.

Mining.

Working a Steep Coal Seam. Austin Y. Hoy. Illustrated description of methods used in the mines of the Pacific Coast Coal Co., at Coal Creek, Wash. 2500 w. Mines & Min—Sept., 1910. No. 16877 C.

Missouri.

See Iowa, under Coal and Coke.

Peat.

Canada's Experimental Peat Plants. A. R. Maujer. Illustrates and describes the method of handling peat on the government bog-lands and its use in a suction gas producer plant. 2200 w. Power—Sept. 13, 1910. No. 17054.

Generation of Power from Peat. T. Arthur Mighill. Abstract of a paper read before the Am. Peat Soc. Discusses the proportion of moisture, preparation of fuel, facilities required for the continuous development of 1000 h.p., and drying the peat. 3200 w. Power—Sept. 6, 1910. No. 16936.

Production.

The World's Coal Production and Consumption. Information from the Board of Trade returns. 3500 w. Col Guard—Sept. 2, 1910. No. 17089 A.

Sampling.

Coal and Coke Sampling. E. G. Bailey. Directions for properly sampling at mines and from cars. 6000 w. Mines & Min—Sept., 1910. No. 16880 C.

Stripping.

Stripping Coal Beds. Illustrates and describes methods in use in the anthracite region of Pennsylvania, and in bituminous coal in Illinois. 1800 w. Mines & Min—Sept., 1910. No. 16876 C.

Tennessee.

The Wind Rock Coal Mine. W. S. Hutchinson. Gives illustrated description of the geology, mining system, undermining, etc. 3000 w. Mines & Min—Sept., 1910. No. 16875 C.

Virginia.

Correllation Thacker Field. Audley H. Stow. Illustrates and describes deposits near the Tug River, in Virginia. 1500 w. Mines & Min—Sept., 1910. No. 16879 C.

Wyoming.

Southern Rock Springs Coal Field, Wyoming. A. R. Schultz. Information concerning the development, available coal, markets, etc. 1500 w. Min Wld—Sept. 3, 1910. No. 16929.

COPPER.

Arizona.

The Superior and Boston Mine. R. L. Herrick. Illustrated description of the system of mining and pump arrangement at McGaw shaft, Globe, Arizona. Copper sulphides. 4500 w. Mines & Min—Sept., 1910. No. 16883 C.

Assaying.

Rapid Electrolytic Determination of Copper. R. C. Benner. Information concerning methods and results, describing apparatus utilizing the rotating electrode. 1500 w. Eng & Min Jour—Sept. 10, 1910. No. 17041.

Copper.

Concentration at Cananea, Mexico. Courtenay De Kalb. Describes this plant as it was in April, 1910, following the ore through the mill. Ills. 4000 w. Min & Sci Pr—Sept. 10, 1910. No. 17124.

Dust Settling.

See Smelting, under Copper.

Matte Converting.

Recent Practice in Copper Matte Converting. Redick R. Moore. Describes improved appliances and methods. 6500 w. Eng & Min Jour—Sept. 3, 1910. No. 16900.

Mexico.

Las Pilares Mine. Edward M. Robb, Jr. Describes deposits of copper ore in Mexico, the mining methods, delayed filling system of stoping, transportation, etc. Ills. 6500 w. Mines & Min—Sept., 1910. No. 16882 C.

Smelter Fumes.

Smelter Fume in Shasta County, California. Sumner S. Smith. An illustrated account of present conditions. 1400 w. Min & Sci Pr—Sept. 17, 1910. No. 17386.

See also Smelting, under Copper.

Smelting.

Hydrocarbon Gas vs. Coke in Smelting Furnaces. John S. Loder. Describes a system of producing gas and smelting therewith, devised by the author, and claiming to be economical and efficient. Ills. 1000 w. Min Wld—Sept. 3, 1910. No. 16927.

Smelting at Nishni Tagil in the Ural Mountains. F. W. Draper. Describes a combination of crude methods and modern practice. 3500 w. Eng & Min Jour—Sept. 24, 1910. No. 17409.

Pyrite Smelting and Sulphuric Acid Manufacture. F. J. Falding and J. Parke Channing. Considers several furnaces desirable to produce gas of uniform composition and quantity for acid manufacture. 4000 w. Eng & Min Jour—Sept. 17, 1910. No. 17146.

Smelting Fine Dust at Copper Queen Smeltery. George B. Lee. Reports experiments which proved that dust chambers 125 ft. long were efficient when gas velocity did not exceed 150 ft. per minute. Diagrams. 700 w. Eng & Min Jour—Sept. 10, 1910. No. 17038.

GOLD AND SILVER.

Alaska.

Some Economic Gold Deposits of Alaska. Francis Church Lincoln. Brief descriptions of the more important gold deposits, with information concerning them. 5000 w. Eng & Min Jour—Sept. 17, 1910. No. 17145.

Assaying.

Experiments with Portland Cement Cupels. T. P. Holt and N. C. Christensen. Describes the experiments and results. 2000 w. Eng & Min Jour—Sept. 17, 1910. No. 17148.

Australia.

Metallurgical Practice in Western Australia. A. E. Drucker. An account of the practice of the leading gold-producers and the production. Ills. 1200 w. Min & Sci Pr—Sept. 24, 1910. No. 17564.

British Columbia.

The Nickel Plate Mine and Mill. Illustration and brief account of this successful gold mine. 1800 w. Min & Sci Pr—Aug. 27, 1910. No. 16854.

California.

Nevada City Gold Mining District, California. A. H. Martin. Historical review of the development of this gold district. Ills. 2000 w. Min Wld—Sept. 24, 1910. No. 17413.

Chlorination.

Electrolytic Chlorine at Mount Morgan, Queensland. B. Du Faur. Read before the Aust. Inst. of Min. Engrs. Detailed description of the method of producing chlorine. Ills. 3500 w. Queens Gov Min Jour—Aug. 15, 1910. No. 17448 B.

West Works—Mount Morgan Chlorination. C. H. Humphreys. Read before the Aust. Inst. of Min. Engrs. A résumé of the work, as an example of what can be effected in recovering the values from oxidized low grade ores. 4000 w. Queens Gov Min Jour—Aug. 15, 1910. No. 17449 B.

Dry Chlorination of Complex Sulphide Ores. H. L. Woolf. Abstract from *Jour. of W. Chem. & Met.* Detailed description of the Malm process. 1200 w. Aust Min Stand—Aug. 3, 1910. No. 16976 B.

Cobalt.

Cobalt in 1910. Arthur A. Cole. Reviews the geology, engineering features and future outlook of this mining district. Ills. 2500 w. Engineering Magazine—Oct., 1910. No. 17547 B.

Colorado.

Geology of Part of Ten-Mile Range, Colorado. Arthur Lakes. Describes the faulting, the prevailing rocks, veins, etc. Ills. 2000 w. Min Wld—Sept. 10, 1910. No. 17060.

Prospecting in San Juan Mountains, Colorado. Arthur Lakes. Illustrates and describes the characteristics of this region. 2000 w. Min Wld—Sept. 17, 1910. No. 17174.

Cyaniding.

The Effect on the Solubility of Gold When Ore Is Crushed Between Iron Surfaces. J. M. Tippett. Reports experiments which seem to show that gold crushed between iron surfaces is not as susceptible to the action of cyanide. 1800 w. Met & Chem Engng—Sept., 1910. No. 16871 C.

Modern Cyanding Practice and Apparatus (Die Praxis des modernen Cyanidprozesses und die zugehörigen Maschinenanlagen). W. Heym. A brief illustrated review of modern developments. Serial. 1st part. 1500 w. Elektrochem Zeitschr—Aug., 1910. No. 17252 D.

Dredging.

See French Guiana, under GOLD AND SILVER.

Fiji.

Geological Features of Fiji. N. D. Cochrane. Information concerning the alluvial, reef, and dredging possibilities. 5000 w. Aust Min Stand—Aug. 3, 1910. No. 16977 B.

French Guiana.

Conditions for Gold Dredging in French Guiana. Albert Bordeaux. Describes the climatic and labor conditions, stating the requirements, costs, etc. 2000 w. Eng & Min Jour—Sept. 17, 1910. No. 17149.

Hydraulic Mining.

Hydraulic Mining of Auriferous Gravels. James W. Phillips. A description of hydraulic mining in California. Ills. Also discussion. 15800 w. Jour W Soc of Engrs—Aug., 1910. No. 17329 D.

See also Débris Barrier, under CIVIL ENGINEERING, WATERWAYS AND HARBORS.

Mexico.

Geology of Hostotipaquillo Ore Deposits. S. J. Lewis. Notes on the geology of this district in Mexico, having extensive deposits of low grade, silver-gold milling ores, and possibly copper. Ills. 2500 w. Min & Sci Pr—Sept. 10, 1910. No. 17126.

San Rafael and Anexas Mining Co. of Pachuca. E. Girault. Abstract of a paper read before the Mex. Min. & Met. Inst. Describes the properties of this company and their development. 4000 w. Min Wld—Sept. 24, 1910. No. 17412.

Montana.

Judith Basin, Montana. Illustrates and describes this region, its mines and their development. 1500 w. Min & Sci Pr—Sept. 24, 1910. No. 17563.

The Radersburg Mining District of Montana and Some Interesting Features of Its Geology. D. C. Bard. Map, with history and present development, and description of the geology, and mineralization. Veins of auriferous pyrite in a gangue of calcite and quartz. 1200 w. Jour Assn of Engng Socs—July, 1910. No. 16828 C.

Mew Mexico.

New Mexico Gold Gravels. J. A. Carruth. Describes deposits of gold-bearing material of great depth and extent. Ills. 3000 w. Mines & Min—Sept., 1910. No. 16884 C.

Precipitation.

Precipitating Gold and Silver from Cyanide Solutions. G. Witteveen. Read before the Inst. of Mines & Met., Mex.

Notes on the De Wilde process. 2500 w. Aust Min Stand—Aug. 24, 1910. No. 17446 B.

Rand.

Rand Mine Returns and the Fathomage System. W. W. Mein. Abstract from advance proofs of an article presented to the Inst. of Min. & Met. A critical review of an address by H. F. Marriott, on methods and costs. 5500 w. Min & Sci Pr —Sept. 24, 1910. No. 17565.

Deep Mining in Transvaal. Roland Gascoyne. Discusses the difficulties due to increase in temperature and pressure. Ills. 2500 w. Min & Sci Pr—Sept. 10, 1910. No. 17125.

IRON AND STEEL.

Analysis.

Iron and Steel Analysis. Warren I. Keeler. Describes a modification of the oxidation method for sulphur. 1400 w. Ir Age—Sept. 1, 1910. No. 16832 C.

Armor Plate.

New Designs of High-Resistance Armor Plate for Dreadnoughts (Neue widerstandsfahigere Panzer für Dreadnoughts mit günstigerer Form für den Einbau). Viktor Tilschkert. Describes recent improvements in armor plate practice. Ills. Serial. 1st part. 2000 w. Oest Zeitschr f Berg- u Hüttenwesen—Aug. 6, 1910. No. 17277 D.

Bessemer Process.

The Present Position of the Basic Bessemer Process in Germany (Zum heutigen Stand des basischen Windfrischverfahrens in Deutschland). Herr Esser. Read at the Düsseldorf Congress. Reviews recent progress, with illustrations from modern plants. Ills. 5400 w. Stahl u Eisen—Aug. 3, 1910. No. 17253 D.

Blast Furnace Charging.

Blast Furnace Charging Abroad. Dr. Alfred Gradenwitz. Illustrates and describes the use of wire rope cableways in Euorpean plants. 1800 w. Ir Age—Sept. 1, 1910. No. 16836 C.

Blast Furnace Charging with Telpher Lines. Plan and illustrated description of a blast-furnace charging plant with telpher lines. 1500 w. Ir & Coal Tds Rev —Sept. 16, 1910. No. 17444 A.

Blast Furnace Gas.

Recent Practice in Gas Cleaning in Germany (Ueber den heutigen Stand der Gichtgasreinigung in Deutschland). Curt Grosse. Read at the Düsseldorf Congress. A detailed review of methods and apparatus. Ills. Serial. 1st part. 3000 w. Stahl u Eisen—Aug. 17, 1910. No. 17260 D.

Blast Furnace Slag.

Aluminium Silicate, Calcium Silicate, and Calcium Aluminate (Die Tonerdesilikate, Kalksilikate und Kalkaluminate). B. Neumann. A study of the properties of these three important constituents of blast furnace slags. Ills. 6000 w. Stahl u Eisen—Aug. 31, 1910. No. 17269 D.

The Colloseus Process for Making Slag Cement. F. A. Talbot. Describes the process, the essential feature being the granulation of the molten furnace slag with epsom salts. 1500 w. Eng & Min Jour—Sept. 24, 1910. No. 17408.

China.

Hanyang Iron and Steel Works. George Chamier. A brief description of the works at Hankow. 2500 w. Engng—Sept. 9, 1910. No. 17306 A.

Electrometallurgy.

The Present Status of Electric Steel Processes. Prof. B. Neumann. Read before the Düsseldorf Cong. Illustrated review of some of the latest improvements in electric steel practice, showing the extension of the field of the electric furnace. 2500 w. Ir & Coal Trds Rev—Aug. 26, 1910. No. 16991 A.

The Nathusius Electric Steel Furnace (Der Elektrostahlofen System Nathusius). B. Neumann. A description of this new combined arc and resistance furnace. Ills. 3500 w. Stahl u Eisen—Aug. 17, 1910. No. 17261 D.

See also Foundry Furnaces, under MACHINE WORKS AND FOUNDRIES.

Germany.

The Future of the German Steel Industry. Discusses the present condition of affairs, the steel syndicate, competition, and related subjects. 4000 w. Ir & Coal Trds Rev—Aug. 26, 1910. No. 16990 A.

Ingot Iron.

American Ingot Iron—Its Development and Production. George L. Fowler. Describes the development of the process and present practice of manufacture, explaining its properties and its demonstration of the probable truth of the electrolytic theory of corrosion. Ills. 3300 w. Ry Age Gaz—Sept. 30, 1910. No. 17574.

Ingots.

The Closing and Welding of Blow Holes in Steel Ingots. Henry M. Howe. Abstract of a paper presented at the Sheffield meeting of the British Assn. Investigates a method of avoiding a portion of the expense of cropping. 2000 w. Ir Trd Rev—Sept. 29, 1910. No. 17573.

Lake Superior.

Production and Resources of Lake Iron Region. John Birkinbine. Information concerning Lake Superior iron ore, which represents about 80% of total production of the United States. 2000 w. Min Wld—Sept. 3, 1910. No. 16928.

Mexico.

The Iron and Steel Industry of Mexico. John Birkinbine. An illustrated descriptive review of present conditions. 9000 w. Ir Age—Sept. 8, 1910. No. 16972.

See also same title, under COAL AND COKE.

New Jersey.

Deep Mining and Treatment of New Jersey Iron Ore. Illustrates and describes modern methods and equipment of an old mining property. 2000 w. Ir Trd Rev—Sept. 22, 1910. No. 17380.

Norway.

The South Varanger Iron Ore Deposits and Separating and Briquetting Plants. Map and illustrated description of large deposits in northern Norway and their development. 3500 w. Engng—Sept. 16, 1910. No. 17436 A.

Ore Resources.

The Iron Ore Resources of the World. L. de Launay. Read before the Int. Cong. of Geologists. Discusses some of the factors determining availability and the sources of supply and probable changes that will influence the production. 2500 w. Ir Age—Sept. 22, 1910. No. 17357.

Plates.

The Etching of Thin Plates (Das Beizen von Feinblechen). W. Krämer. Describes various methods and types of apparatus for cleaning plates for galvanizing. Ills. 3200 w. Stahl u Eisen—Aug. 24, 1910. No. 17264 D.

Rolling Mills.

Power Required for Rolling Steel. J. A. Knesche. First of two articles giving an illustrated description with data and results of tests. 3500 w. Engineering Magazine—Oct., 1910. No. 17550 B.

The Manufacture of Rolled H-Beams. G. E. Moore. Read before the Ir. & St. Inst., England. Reviews the development of the universal mill for rolling of structural shapes. Ills. 5500 w. Ir Age—Sept. 29, 1910. No. 17559.

The Flattening Effect of Rolling (Das Breiten beim Walzen). Correspondence on E. M. Scheld's paper on this subject in *Stahl und Eisen* for March 9, 1910. Ills. 3000 w. Stahl u Eisen—Aug. 17, 1910. No. 17263 D.

Electric Driving of Plate Rolling Mills (Commande électrique de Laminoirs à Toles). A. Mauduit. Describes the installation and practice at the Louvroil plate works. Ills. 5000 w. Génie Civil—Aug. 27, 1910. No. 17239 D.

Segregation.

Segregation in Soft Steel Ingots. From a paper by Prof. Wüst and Herr Felser detailing the results of valuable research work on the effect of segregation on rolled material as shown in tensile and shock tests. Ills. 2500 w. Ir Age—Sept. 29, 1910. No. 17561.

Steel Works.

Design of Steel Mill Building. F. E. Davidson. Brief description of the new open hearth building of the Ill. Steel Co., at its South Works, with general discussion. 3000 w. Jour W Soc of Engrs—Aug., 1910. No. 17330 D.

Control of Extension and Improvement Expenditure in Steel Works (Zur Kontrolle der Neubaukosten auf Hüttenwerken). Discusses provision for improvements, supervision of improvement work, and the determination of costs. Ills. 3000 w. Stahl u Eisen—Aug. 3, 1910. No. 17254 D.

LEAD AND ZINC.

British Columbia.

Geology and Ore Deposits of La France Creek. Newton W. Emmens. Illustrated account of the West Kootenay division of British Columbia, describing the district, particularly along La France Creek, and the La France mines. 1700 w. Min Wld—Sept. 10, 1910. No. 17058.

Lead Smelting.

Trail Smelter and Lead Refinery. J. M. Turnbull. Illustrated description of the equipment, methods of smelting and electrolytic refining. 7000 w. Mines & Min—Sept., 1910. No. 16885 C.

MINOR MINERALS.

Asbestos.

The Asbestos Industry in Central Wyoming. F. H. Barrow. Information concerning the quantity, quality, and development. Ills. 800 w. Eng & Min Jour—Sept. 17, 1910. No. 17147.

Cement.

The Portland Cement Industry of the United States and Canada. Arthur Charles Davis. Reviews the development of the industry. 4500 w. Inst of Civ Engrs—No. 3851. No. 17377 N.

The Rotary Kiln. Ellis Soper. On the development and uses. Ills. 2200 w. Jour Am Soc of Mech Engrs—Oct., 1910. No. 17582 F.

The Fuel Requirements of the Rotary Cement Kiln. W. S. Landis. Discusses this subject from both the theoretical and practical standpoints. 2500 w. Met & Chem Engng—Sept., 1910. No. 16872 C.

The Cement Mill of the Los Angeles Aqueduct. Illustrated detailed description of a 1000-bbl. cement mill operated municipally. 2000 w. Eng Rec—Sept. 17, 1910. No. 17158.

The Equipment of the Cement Mill of the Portland Cement Company of Utah. Leroy A. Palmer. Illustrated description of a remodeled mill equipment, as an example of the most advanced type of cement manufacture. 2200 w. Eng News—Sept. 8, 1910. No. 16998.

Fireclay.

The Application of the Grog in Firebrick Manufacture. Gilbert Rigg. Considers the important parts played by the grog in fireclay ware, the chemical composition, the application of the grog in such a manner as to give the greatest density, etc. 2200 w. Met & Chem Engng—Sept., 1910. No. 16873 C.

Magnesite.

The Economic Value of the Kraubath Magnesite (Ueber die Beurteilung des wirtschaftlichen Wertes des Gel-Magnesits von Kraubath). A. Granigg. A detailed study of extensive magnesite deposits in Austria. Ills. Serial. 1st part. 1500 w. Oest Zeitschr f Berg u Hüttenwesen—Aug. 27, 1910. No. 17279 D.

Tin.

Tin Mining in Bolivia. William Gray and Arnold L. Halden. Information concerning the centers of production, economic conditions, and mining laws. Map. 1600 w. Min Mag—Sept., 1910. No. 17517 B.

Mount Bischoff. F. H. Bathurst. An illustrated descriptive account of the greatest tin mine in the world, its discovery and history. 3500 w. Min Mag—Sept., 1910. No. 17516 B.

Tungsten.

Scheelite. Brief illustrated account of a new tungsten mining camp in Nova Scotia. 1200 w. Can Min Jour—Sept. 15, 1910. No. 17172.

MINING.

Accidents.

Accidents from Explosions in 1909. Information from the last report of H. M. Inspectors of explosives. 2500 w. Col Guard—Aug. 26, 1910. No. 16960 A.

The Prevention of Mine Accidents. Report of a Committee of the Am. Min. Cong. giving draft of a law for the regulation of quarrying and metalliferous mining, urging its uniform adoption in the hope of reducing accidents. 9000 w. Eng & Min Jour—Sept. 24, 1910. No. 17407.

Depth.

Practical Limit to the Depth of Mines. Dr. Niess, in *Umschau*. Discusses the improvements that have made possible deep mining, and the greatest depth at which mining can be carried on. 2000 w. Sci Am Sup—Sept. 24, 1910. No. 17364.

Drills.

Compressed-Air Drills (La Perforation mécanique par Percussion à l'Air comprimé). Henri Petit Bois. General notes on the calculation of output, air consumption, etc. Ills. 2500 w. All Indus—Aug., 1910. No. 17231 D.

Rock Drills in Sweden (Die Verwendung von Gesteinbohrmaschinen in den schwedischen Bergwerken). E. Mossberg. Describes the drills used, the applications made of them, and the results obtained. Ills. 6500 w. Glückauf—Aug. 6, 1910. No. 17280 D.

Electric Hoisting.

Bibliography to Accompany Paper on Electric Mine-Hoists. L. B. Rushmore and K. A. Pauly. 9 pages. Bul Am Inst of Min Engrs—Sept., 1910. No. 17346 F.

Electric Power.

Electricity in Mining (Electrizität im Bergbau). W. Philippi. A brief review of its various applications. Ills. 3000 w. Elek Kraft u Bahnen—Aug. 24, 1910. No. 17483 D.

Explosive Testing.

Some Modern Developments in Methods of Testing Explosives. Charles E. Munroe. Illustrates and describes the Pittsburg testing station and its equipment, and the experimental investigations carried out. 8000 w. Pro U S. Nav Inst—Sept., 1910. No. 17323 F.

Haulage.

Underground Haulage (Streckenförderung unter Tage). Fr. Tillmann. Read at the Düsseldorf Congress. A review of mechanical haulage practice in Germany. Ills. Serial. 1st part. 3600 w. Glückauf—Aug. 6, 1910. No. 17281 D.

See also Signalling, under STREET AND ELECTRIC RAILWAYS.

Hoisting.

Underground Winding Plant of the New Modderfontein G. M. Co. R. H. Copeland. Abstract of paper before the S. African Inst. of Elec. Engrs. Shows difficulties met in installing the cable, getting the hoist into position, and describes the system of control, etc. 2000 w. Elect'n, Lond—Aug. 26, 1910. No. 16953 A.

The Economy and Safety of Modern Hoisting Plants (Wirtschaftlichkeit und Sicherheit moderner Schachtförderanlagen). A. Winkel. A review of the status and recent development of hoisting machinery. Ills. 2500 w. Zeitschr d Ver Deutscher Ing—Aug. 6, 1910. No. 17492 D.

Hoisting Engines.

Twin Tandem Winding Engines. Illustrates and describes engines recently built for a colliery in South Wales. Plate. 1200 w. Engr, Lond—Sept. 9, 1910. No. 17313 A.

Results of Tests of Steam and Electric Hoisting Plants (Ergebnisse von Untersuchungen an elektrisch und mit Dampf betriebenen Fördermaschinen). Tabulated results of tests on plants in the Dortmund district. 1500 w. Glückauf—Aug. 27, 1910. No. 17287 D.

Law.

New Zealand and American Mining Law—A Contrast. A. C. Veach. Abstract from reports on "Mining Laws of Australia and New Zealand." Government-Printer, Washington, 1910. 1800 w. Min & Sci Pr—Aug. 27, 1910. No. 16855.

Methods.

Mining and Stoping Methods in the Coeur d'Alene. John Tyssowski. Long tunnel entries are common. Methods are illustrated and described. 3000 w. Eng & Min Jour—Sept. 3, 1910. No. 16898.

Lessons from Gilpin County Practice. George E. Collins. Abstract from lectures before the Colo. Sch. of Mines. Describes good and bad points of methods in a district of small mines and variable ore bodies. Ills. 5400 w. Min & Sci Pr—Sept. 17, 1910. No. 17384.

Underground Methods on the Gogebic Range. Percival S. Williams. Read before the L. Superior Min. Inst. Illustrates and describes development work. 2200 w. Min Wld—Sept. 10, 1910. No. 17059.

Plants.

Low-Pressure Steam Turbines in Mining Plants. Frank C. Perkins. Illustrates and describes applications of these turbines which utilize the exhaust steam. 1500 w. Min Wld—Sept. 3, 1910. No. 16925.

Shaft Sinking.

Concrete Shaft Linings and the Deepening of the Shaft of the Austrian Mining and Smelting Company (Ueber Schachtbetonierungen im allgemeinen und das Abteufen der Schächte bei der Oesterreichischen Berg- und Hüttenwerks-Gesellschaft). A Czermak. Detailed description of the sinking and tubbing work. Ills. Serial. 1st part. 3000 w. Oest Zeitschr f Berg u Hüttenwesen—Aug. 6, 1910. No. 17276 D.

Skip Hooks.

Kibble Hooks. From *Zeit. für Berg., Hutten und Salinenwesen.* Substances of reports required by the Prussian Minister of Commerce, on the different types of kibble hooks in use. Ills. 1200 w. Col Guard—Aug. 26, 1910. No. 16961 A.

Stowing.

Effect of Sand Filling on the Surface in the Königin Luise District (Wirkungen des Abbaues mit Sandspülversatz auf das Deckgebirge im Felde der Königin Luise-Grube). Herr Ackermann. Describes earth subsidence in this German coal field. Ills. 4000 w. Glückauf—Aug. 20, 1910. No. 17283 D.

Stripping.

See same title, under COAL AND COKE.

Surveying.

Details of Mine Surveying. A. E. Robinson. Describes methods recently employed in conducting an extensive survey. 6000 w. Min & Sci Pr—Sept. 3, 1910. No. 17011.

Timbering.

Underground Steel Construction in Mines. R. B. Woodworth. An illustrated review of uses made of steel in mines, showing types and discussing stresses in mine timbering. 4500 w. Min Wld—Sept. 17, 1910. No. 17173.

ORE DRESSING AND CONCENTRATION.

Briquetting.

Nodulizing Wet Iron Ores. Abstract of a paper by Friedrich Witte, in *Stahl und Eisen,* describing the nodulizing process at the Fernie Works, near Giessen, as applied to a soft brown iron ore. Ills. 1000 w. Ir Age—Sept. 1, 1910. No. 16835 C.

Copper.

The Ohio Concentrator. Leroy A. Palmer. Describes this concentrator of the Ohio Copper Co., in Utah, and its operation. Ills. 3000 w. Min & Sci Pr—Sept. 3, 1910. No. 17012.

Crushing.

Comparison of Gyratory and Jaw Crushers. H. L. Wollenberg. Shows that each type has a field in which it is superior, and discusses the limits of each. 2500 w. Eng & Min Jour—Sept. 10, 1910. No. 17039.

Lead Milling.

The New Ore-Dressing Plant at the Diepenlinchen Mine near Stolberg (Die neue Erzaufbereitungsanlage der Grube Diepenlinchen bei Stolberg). Herr Cabolet. Illustrated description of an important German plant for the treatment of lead-zinc ores. Ills. 5000 w. Glückauf—Aug. 27, 1910. No. 17284 D.

Roasting.

Notes on Roasting and Sintering; With Particular Reference to the Dwight & Lloyd Process. F. M. Smith. Reports concerning the development and results of this process. 2500 w. Jour Assn. of Engng Socs—July, 1910. No. 16830 C.

Stamp Mills.

Pittsburg—Silver Peak Mining Co.'s Mills, Nevada. A. H. Martin. Detailed description of the most economical mill in southern Nevada. 2000 w. Min Wld—Sept. 10, 1910. No. 17061.

Tailings Disposal.

Silting at Waihi. Arthur Jarman. An illustrated account of an inquiry into the damage claimed, and suggestions for improving conditions. 1800 w. Min Mag—Sept., 1910. No. 17515 B.

MISCELLANY.

Canada.

The Eastern Canadian Mineral Belt. Theo. F. Von Wagenen. Describes the region between the Great Lakes and Hudson Bay. 2500 w. Min & Sci Pr—Sept. 17, 1910. No. 17385.

China.

Mines in the Yangtzi Valley, China. Kimio Nishizawa. An account of mining in China, and the steps taken to develop the industry with information concerning conditions, climate, etc. 7500 w. Jour Soc of Arts—Sept. 16, 1910. No. 17416 A.

Conservation.

President Taft on Conservation of Mineral Land. Remarks taken from the speech at St. Paul, before the Nat. Conservation. Cong. recommending leasing mineral rights only in government coal, oil and phosphate lands. 2500 w. Eng & Min Jour—Sept. 10, 1910. No. 17037.

India.

The Mineral Production of India. Information from the last issue of the Records of the Geological Survey of India, concerning development, production, trade, etc. 2000 w. Col Guard—Aug. 26, 1910. No. 16962 A.

Ore deposits.

The Effect of Oxidation on the Value of a Mineral Deposit. J. Bowie Wilson. Discusses effects that should be understood in valuing a new mine or prospect. Its effect on the contents of the ore, on the physical character of the ore body, etc. 3500 w. Anst Min Stand—Aug. 24, 1910. No. 17447 B.

Exploration of Contact Metamorphic Ore Deposits. C. A. Stewart. A summary of modern theories and opinions of the character and genesis of such deposits. 2500 w. Eng & Min Jour—Sept. 10, 1910. No. 17040.

Manganese-Ore in Unusual Form. William P. Blake. Describes a deposit near Tucson, Ariz., as an example of ore-deposition by vadose upward capillary flow of metal-bearing solutions with concentration at the surface of the country rock. 800 w. Bul Am Inst of Min Engrs—Sept., 1910. No. 17348 F.

Quebec.

Report of Mining Operations in the Province of Quebec During the Year 1909. Theodore C. Denis. Abstract of the report of the Supt. of Mines. 4000 w. Can Min Jour—Sept. 1, 1909. No. 16893.

Refractory Materials.

Changes in the Composition of Firebricks. Dr. Blasberg. Read before the Düsseldorf Cong. Tabulated analyses of several kinds of fireproof brick from blast furnaces, cupolas, etc., and of coke oven bricks, and silica bricks from open hearth furnaces, with a study of the changes. 2500 w. Ir & Coal Trds Rev—Aug. 26, 1910. No. 16989 A.

RAILWAY ENGINEERING.

CONDUCTING TRANSPORTATION.

Accidents.

The Campaign Against Accidents on the Chicago & North Western. Explains the methods being adopted to reduce accidents. 3000 w. Ry Age Gaz—Sept. 2, 1910. No. 16860.

Signalling.

Note on the Double Application of the M. D. M. Automatic Route Combiner to the Hydraulic Operating Gear and to the Interlocking of the Points and Signals at the Landy Signal Cabins, near Paris, by the French Northern Railway. A. Moutier. Ills. 3300 w. Bul Int Ry Cong—July, 1910. No. 17543 G.

Railway Signalling in India. Charles William Hodson. Describes the development of signalling apparatus, discussing improvements desired, methods, etc. Discussion. Ills. 28000 w. Inst of Civ Engrs, No. 3802—Dec. 14, 1909. No. 17367 N.

Report No. 4 for Great Britain and Colonies, Belgium, France, and Italy on the Question of Operation of Switches and Signals. L. Weissenbruch and J. Verdeyen. A discussion of improved control installations for the operation of points and signals, comparing systems, etc. Ills. 14500 w. Bul Inst Ry Cong—July, 1910. No. 17544 G.

The New Electro-Pneumatic Signal System for the West Side of the Central Station at Amsterdam (De nieuwe electro-pneumatische Seininrichting voor de Beveiliging van de Westzijde van het Centraalstation te Amsterdam). A. van Driel van Wageningen. Illustrated detailed description. 7000 w. De Ingenieur —Aug. 20, 1910. No. 17505 D.

Train Dispatching.

Telephone Train Dispatching. K. W. Endres. An illustrated explanation of its advantages, and detailed discription. 1800 w. Elec Rev, N. Y—Sept. 24, 1910. Serial. 1st part. No. 17406.

Train Speed.

Determination of Regular and Minimum Running Time (Die Bestimmung der regelmässigen und der kürzesten Fahrzeit). Herr Wagner. Describes the method of determining running time and establishing schedules, taking account of curvature and grades. Ills. 2200 w. Glasers Ann—Aug. 15, 1910. No. 17456 D.

MOTIVE POWER AND EQUIPMENT.

Air Brakes.

Braking Power Chart. Gives a chart showing weight of car and braking power, with explanation. 700 w. Ry & Loc Engng—Sept., 1910. No. 16897 C.

Rapidity of Braking with Pressure and Vacuum Brakes (Fortpflanzungsgeschwindigkeit der Bremswirkung bei Druckluft- und Vakuumbremsen). A. Langrod. Examines the factors influencing the speed of brake action. Ills. 3000 w. Glasers Ann—Aug. 1, 1910. No. 17453 D.

Electrification.

The Electrification of Steam Railways. An editorial study of papers on this subject recently read before the joint meeting of the British and American Mechanical Engineering Societies. 5000 w. Eng News—Sept. 22, 1910. No. 17355.

The Electrification of Steam Roads. R. R. Keely. Summarizes the advantages and disadvantages of electrification, discussing the relative merits of the various systems, and gives tabulated lists of important electric railways. Ills. 3500 w. Can Engr—Sept. 15, 1910. Special. No. 17182 C.

Electric Power for Railroad Operation. F. Darlington. Based on a lecture delivered before the Richmond R. R. Club. Discusses the commercial aspect of electrification, the systems, comparison with steam, and between old and new electric systems. 4000 w. Elec Jour—Sept., 1910. No. 16825.

Freight Cars.

The Economics of Large-Capacity Freight Cars (L'Intérêt économique des Wagons de grande Capacité). Pierre Arbel. Discusses the use of large-capacity cars in Europe from the points of view of the railways and the shippers, and examines the principles of proper rate making. Ills. 14000 w. Mem Soc Ing Civ de France—July, 1910. No. 17203 G.

Locomotive Construction.

Equalization of Mallet Articulated Locomotives. W. E. Johnston. A criticism of the three point support used in American practice in designing this type of engine. Ills. 800 w. Am Engr & R R Jour —Sept., 1910. No. 16921 C.

Progress of Locomotive Construction in Canada. Lacey R. Johnson. Illustrates and describes various designs for the varied services required. 2500 w. Can Engr—Sept. 15, 1910. Special. No. 17180 C.

Locomotive Design.

The Design of Rolling Stock for Smooth-Rail Working on Heavy Gradients. Frederick William Bach. Discusses the constructional and economic considerations which should govern the design. Also discussion. Ills. 22000 w. Inst of Civ Engrs, No. 3787—Jan. 11, 1910. No. 17366 N.

Locomotive Efficiency.

Influence of Steam Pressure on Locomotive Efficiency. Charles R. King. Considers the gradual increase in steam pressures, and discusses the influence upon the economy in compound locomotives, giving tabulated data relating to the reduction of steam pressures on the State Railways of Italy. 3000 w. Mach (Ry Ed)—Sept., 1910. No. 16986 C.

Locomotives.

Development of Articulated Locomotives. C. H. Caruthers. Illustrated review of types since 1831. 2500 w. Ry Age Gaz—Sept. 30, 1910. No. 17576.

Report on the Question of Locomotives and Rolling Stock of Narrow-Gauge Light Railways. Moriz Jesser. Illustrated discussion of the latest types. 31000 w. Bul Int Ry Cong—July, 1910. No. 17541 G.

Locomotives at the Brussels Exhibition. Illustrated detailed description of exhibits. 1500 w. Engr, Lond—Aug. 26, 1910. Serial. 1st part. No. 16973 A.

Locomotives for the Carolina, Clinchfield & Ohio Railway. Illustrated description of a Mallet 2-6-6-2, and a Pacific 4-6-2. 1500 w. Ry & Loc Engng—Sept., 1910. No. 16896 C.

Freight (2-6-6-2 Type) and Passenger (4-6-2 Type) Locomotives for a Low Grade Line. Illustrated descriptions of engines for the Carolina, Clinchfield & Ohio Railway. 1600 w. Am Engr & R R Jour—Sept., 1910. No. 16922 C.

Articulated Compound Locomotives, 0-8-8-0 Type. Illustrated description of engines designed by the Am. Loc. Co. for the Norfolk & Western Railway. 900 w. Am Engr & R R Jour—Sept., 1910. No. 16920 C.

Heavy Pacific Tpye Locomotive for the Vandalia. Illustrated detailed description of an engine for heavy passenger service, with record of typical runs. 1000 w. Ry Age Gaz—Sept. 23, 1919. No. 17398.

Four-Cylinder Compound Locomotive with Superheater "Helicoidalen Cascade." Illustrated detailed description of one of a series of 70 locomotives built for fast service on long divisions on the Eastern Ry. of France. 4000 w. Ry & Engng Rev—Sept. 17, 1910. No. 17175.

New French Pacific Express Engine, Chemin de Fer du Midi. Illustration and brief description of this new engine for passenger service. Plate. 150 w. Engr, Lond—Sept. 16, 1910. No. 17441 A.

Four-Cylinder Compound with Three Coupled Axles on the Austrian State Railways (Note sur la Locomotive compound à Quatre Cylinders à trois Essieux accouplés, Essieux porteur à l'avant et Bogie à l'Arrière, Serie 210, des Chemins de Fer I. R. de l'Etat Autrichien). Jacques Neblinger. Detailed description of a locomotive of the 2-6-4 type. Ills. 4500 w. Rev Gen d Chemins de Fer—Aug., 1910. No. 17218 G.

Water-Tube Locomotives for the Northern Railway of France (Locomotive avec Foyer à Tubes d'Eau de la Compagnie du Chemin de Fer du Nord). Brief description, with plate. Ills. 2500 w. Génie Civil—Aug. 13, 1910. No. 17234 D.

Locomotive Superheaters.

Churchward Superheater. Trans. from *Rev. Gen. des Chem. de Fer.* Illustrated description. 1500 w. Ry & Engng Rev —Sept. 17, 1910. No. 17176.

Churchward Superheaters on the Locomotives of the Great Western Railway (Note sur le Surchauffeur Système Churchward des Locomotives du Great Western Railway). L. Fort and F. Houlet. Describes the Churchward superheater and compares with other types. Ills. 2000 w. Rev Gen d Chemins de Fer —Aug., 1910. No. 17217 G.

Locomotive Throttles.

New Throttle Valves for Superheated-Steam Locomotives (Neue Ventilregler für Heissdampf-locomotiven). M. Henze. Describes briefly the Schmidt & Wagner Throttle. Ills. 1000 w. Elektrotech Rundschau—Aug. 4, 1910. No. 17473 D.

Motor Cars.

Auto as Locomotive. William D. Ennis. Considers the motor car from the standpoint of the automobile designer discussing the proportions of a typical example. Ills. 3000 w. Automobile—Sept. 29, 1910. No. 17570.

Converted Automobile Motor Car. Illustrated description of a car remodeled and used on the A., T. & S. F. Ry. in Texas. 600 w. Ry Age Gaz—Sept. 9, 1910. No. 17017.

A Freight and Passenger Railway Using Gasoline Motor Cars. Information concerning a standard-gauge railway in Iowa, over which both freight and passenger traffic will be handled by means of cars driven by gasoline engines. 1800 w. Eng Rec—Sept. 10, 1910. No. 17049.

Shops.

Locomotive Repair Shop Practice. Ethan Viall. Illustrates and describes work at the C., R. I., & P. R. R. shops, Silvis, Illinois. 1800 w. Mach (Ry Ed) —Sept., 1910. No. 16985 C.

The Modern Locomotive Repair Shop. A. D. Porter. Gives plans and description of such shops able to care for 10 to 12 locomotives. 1500 w. Can Engr—Sept. 15, 1910. Special. No. 17181 C.

New Shops at the Midland Railway Carriage and Wagon Works, Derby. Illustrated detailed description of new features introduced and general description of the works. 4000 w. Engr, Lond—Sept. 2, 1910. No. 17098 A.

The Borsig Locomotive Shops. V. Litz. Illustrates and describes interesting features of shop construction, and special machines. 1500 w. Am Mach—Vol. 33. No. 37. No. 17116.

Equipment of the Schneidemühl Locomotive Repair Shops (Maschinelle Einrichtungen der Lokomotiv-Reparatur-Werkstatt Schneidemühl). Herr Wolff. Detailed description of this German plant. Ills. Serial. 1st part. 2300 w. Glasers Ann—Aug. 15, 1910. No. 17455 D.

Sleeping Cars.

A New Idea in Sleeping Cars. M. M. Hunting. Illustrates and describes the novel features of an improved car for interurban service. 500 w. Sci Am—Oct. 1, 1910. No. 17536.

Train Lighting.

The Production of Oil Gas in Producers and Its Transmission under High Pressure (Oelgasherstellung in Generatoren und Gasfernversorgung in Hochdruckleitungen). Fritz Landsberg. Gives results and costs of operation of the Pankow plant. Ills. 3300 w. Glasers Ann—Aug. 1, 1910. No. 17454 D.

Train Resistance.

Freight Train Resistance. Discussion of Prof. Edward C. Schmidt's paper. 4000 w. Jour Am Soc of Mech Engrs—Sept., 1910. No. 16818 F.

PERMANENT WAY AND BUILDINGS.

Bridges.

Report No. 11 for Russia on the Question of Strengthening the Bridges with a View to Increasing the Weight of Locomotives and the Speed of Trains. N. Belelubsky and N. Bogouslawsky. The suitable strengthening of existing metal bridges is considered. Ills. 31600 w. Bul Int Ry Cong—July, 1910. No. 17542 G.

Coaling Stations.

Operating and Maintenance Costs of Locomotive Coal and Ash Handling Stations. Henry J. Edsall. Gives data in regard to the cost of operating and maintaining various types of locomotive coaling stations. 1500 w. Eng News—Sept. 8, 1910. No. 17004.

See also same title, under CIVIL ENGINEERING, Construction.

Construction.

Grading Work on the C. N. O. Railway, Toronto-Ottawa Line. Illustrates and describes methods of excavating and filling, and some of the bridges. 500 w. Can Engr—Sept. 15, 1910. Special. No. 17177 C.

Curves.

Straight Run-Outs of Cant at the Ends of Circular Curves on Railways. Fulwar Craven Fowle. A study of the effect of cant, with calculation of the required cant. 2500 w. Inst of Civ Engrs—No. 3867. No. 17276 N.

Rail Joints.

Improvements and Experiments in Rail Joints. Information from recent papers before the International Railway Congress. 2500 w. Eng News—Sept. 15, 1910. No. 17107.

Reconstruction.

Recent Improvements of the Oregon & Washington Railroad. A brief account of extensive improvements in progress and proposed at Tacoma and Seattle, Wash. Ills. 1200 w. Eng Rec—Sept. 24, 1910. No. 17401.

Stations.

Reinforced Concrete Depot at Grand Prairie, Tex. Brief illustrated description of a reinforced-concrete station, costing $6000 for a town of 300 inhabitants. 200 w. Ry Age Gaz—Sept. 9, 1910. No. 17014.

Terminals.

Opening of the Pennsylvania Terminal Station in New York. Brief illustrated account of the work of bringing this railroad into the metropolis. 1500 w. Sci Am —Sept. 10, 1910. No. 17020.

Inaugural of the New York Extension of the Pennsylvania Railroad: Opening of the Passenger Station. An illustrated summary of the main structural features of this great work and a historical sketch of the development of the project. Also editorial. 11000 w. Eng News—Sept. 15, 1910. No. 17104.

Progress at the Grand Central Terminal. Illustrations showing present conditions at this New York City terminal, and showing the progress on the new station. Descriptive notes. 1000 w. Ry Age Gaz —Sept. 16, 1910. No. 17134.

Track Construction.

The Strengthening of Railway Track for High-Speed Traffic. Notes from papers on this subject at the recent International Railway Congress, with editorial. 4000 w. Eng News—Sept. 8, 1910. No. 17006.

Track Location.

Angular Loading-Track Arrangement for Panama R. R. Docks at Cristobal. E. B. Karnopp. A study of track layout for serving the new dock, showing that the position of loading tracks can affect the cost of handling about 20%. Plans. 700 w. Eng News—Sept. 29, 1910. No. 17527.

Tunnels.

Supplement to Report No. 1 on the Question of Long Railway Tunnels, Construction, Ventilation and Operation. Francis Fox. Great town tunnels in Great Britain. 100 w. Bul Int Ry Cong—July, 1910. No. 17545 G.

A New Alpine Tunnel Project—the Little St. Bernard (Une nouvelle Percée des Alpes—le Petit Saint-Bernard). J. Révil. A description of the project based on an examination of the region. 4000 w. Rev Gen Sci—Aug. 30, 1910. No. 17222 D.

Water Towers.

The New Water Works at the Potsdam Station, Berlin (Das neue Wasserwerk am Potsdamer Bahnhof in Berlin). Herr Zinkeisen. Describes a locomotive water station and pumping plant. Ills. 3000 w. Glasers Ann—Aug. 1, 1910. No. 17452 D.

TRAFFIC.

Demurrage.

The Car Demurrage Bureaus. William Bender Wilson. Remarks on the advantages derived from these bureaus, and the agitation with the object of their abandonment, giving a summary of the reasons advanced. 1500 w. Ry Age Gaz—Sept. 9, 1910. No. 17016.

MISCELLANY.

Canada.

Railway Development in Canada. R. A. Baldwin. Reviews the beginning and growth of the system of railways, and some points relating to the early history of railway building in Great Britain. 3500 w. Can Engr—Sept. 15, 1910. Special. No. 17178 C.

Railway Situation in Canada. J. L. Payne. Interesting statistics relating to the railway facilities, and information concerning their financial condition. Map. 3000 w. Can Engr—Sept. 15, 1910. Special. No. 17179 C.

Great Britain.

Prof. Dalby's Address to Section G of the British Association. (Abstract.) Gives reliable statistics relating to British railways, discussing electrification. Considers electric service necessary where frequent starts and stops are involved, and shows the influence of scientific discovery on the railways. 5000 w. Elect'n, Lond—Sept. 2, 1910. No. 17078 A.

Italy.

Transportation and Traffic in Italy. Logan G. M'Pherson. Preliminary report to the Nat. Waterways Com. Information concerning waterways and railways, reviewing their history and development. 4000 w. Ry Age Gaz—Sept. 9, 1910. No. 17013.

Java.

Railways and Tramways in Java (De Spoor- en Tramwegen op het Eiland Java). J. Th. Gerlings. A brief review of the transportation facilities. 4000 w. De Ingenieur—Aug. 6, 1910. No. 17503 D.

Philippines.

Philippine Railway Company Lines. Abstract from the *Far Eastern Rev.* Illustrates and describes construction work under very difficult conditions. 1600 w. Ry Age Gaz—Sept. 30, 1910. No. 17575.

Sicily.

Narrow-Gauge Railways in Sicily (La Rete complementare Sicula a Scartamento ridotto). A detailed study of secondary lines in Sicily. Ills. Serial. 1st part. 3000 w. Ing Ferro—Aug. 1, 1910. No. 17246 D.

Switzerland.

Transportation and Traffic in Switzerland. Logan G. M'Pherson. A preliminary report to the Nat. Waterways Com. A review of the history of the Swiss railways. 3000 w. Ry Age Gaz—Sept. 30, 1910. No. 17577.

STREET AND ELECTRIC RAILWAYS.

Bradford, Eng.

The Tramways of Bradford. Illustrated general description of the tramway undertaking and its operation. Map. 6000 w. Tram & Ry Wld—Sept. 1, 1910. No. 17082 B.

Car Barns.

Park Terminal Car House, Baltimore. Illustrated detailed description, as an example of the best modern practice. 2000 w. Elec Ry Jour—Sept. 17, 1910. No. 17132.

Cars.

New Open Cars of the Massachusetts Electric Companies. An account of rapid methods of construction. Ills. 1500 w. Elec Ry Jour—Oct. 1, 1910. No. 17578.

Conductor Maintenance.

Brooklyn Line Department—Third Rail Maintenance, High-Tension Work, Feeders and Miscellaneous Features. Fifth article of a series describing the line department of the Brooklyn Rapid Transit System. Ills. 3000 w. Elec Ry Jour—Sept. 10, 1910. No. 17010.

Germany.

The Electric Railways in Germany. Wilhelm Weehmann. An outline of the electric railways in Germany at the present time. 3000 w. Ry Age Gaz—Sept. 23, 1910. No. 17399.

Interurban.

Promotion of Interurban and Branch Railways. J. Stanley Richmond. A criticism of the government regulations in Canada. 3000 w. Can Engr—Sept. 15, 1910. Special. No. 17183 C.

Interurban Railways Centering in Toronto. Illustrated account of the lines entering Toronto, and information relating to them. 2500 w. Can Engr—Sept. 15, 1910. Special. No. 17184 C.

Southern Cambria 1200-Volt D. C. Railway. Illustrated description of an interurban line in western Pennsylvania. 1200 w. Elec Ry Jour—Sept. 3, 1910. No. 16864.

The Heddernheim - Oberursel - Hohe Mark Railway (Vorortbahn Heddernheim-Oberursel-Hohe Mark). Brief description of an interurban high-speed line near Frankfurt a. M. Ills. 2200 w. Elek Kraft u Bahnen—Aug. 4, 1910. No. 17479 D.

Java.

See same title, under RAILWAY ENGINEERING, MISCELLANY.

Locomotives.

An Electric-Turbine Locomotive. Illustrated description of the recently constructed Reid-Ramsey electro-turbo locomotive. 1200 w. Tram & Ry Wld—Aug. 4, 1910. No. 16487 B.

Electric Turbine Locomotive Built at Glasgow. Illustrated description of a novel engine—the Reid-Ramsay locomotive. 600 w. Ry & Loc Engng—Oct., 1910. No. 17655 C.

New 60-Ton Locomotives of Illinois Traction Company. Illustrated detailed description of locomotives to be used in handling freight. 1000 w. Elec Ry Jour—Oct. 8, 1910. No. 17737.

An Electric Freight Locomotive for City Lines. Brief description of a locomotive built for the Brooklyn lines of the Rapid Transit Co. 1000 w. Eng News—Sept. 29, 1910. No. 17532.

The Pennsylvania Electric Locomotives and Their Field of Operation. H. L. Kirker. A conversational detailed description, with illustrations. 3000 w. Elec Jour—Sept., 1910. No. 16822.

Monorail.

Gyroscope in Monorail Cars (Chemins de Fer Monorails à Gyroscopes stabilisateurs). Ch. Dantin. A brief review of gyroscopic theories and of monorail systems. Ills. 2000 w. Génie Civil—Aug. 20, 1910. No. 17237 D.

The Technical and Economic Possibilities of Gyroscope Monorailways (Die technischen und wirtschaftlichen Aussichten der einschienigen Kreiselbahnen). Alfred Kürth. Replies to criticisms and discusses the advantages of the monorail system, particularly Scherl's. Ills. 5000 w. Elek Kraft u Bahnen—Aug. 14, 1910. No. 17480 D.

Motor Pinions.

Breakages of Railway Motor Pinions. George L. Fowler. Reports an investigation made of pinion breakage and the conclusions. Ills. 2500 w. Elec Ry Jour—Sept. 3, 1910. No. 16865.

Operation.

Some Practical Hints Regarding Electric Tramway Operation. Directions for troubles that frequently occur. 2200 w. Elec Rev, Lond—Aug. 26, 1910. No. 16944 A.

Pittsburg.

Rapid Transit Problems. Report on conditions at Pittsburg from investigations made by Bion J. Arnold. Ills. 3000 w. Munic Jour & Engr—Sept. 7, 1910. No. 16982.

Rack Railways.

The Mendel and Rittner Railway (Die Mendel- und Rittnerbahn). M. Jesser. Describes an electric railway in Austria, partly on the adhesion, and partly on the rack, system. 3500 w. Mitt d Ver f d Förd d Lokal u Strassenbahnwesens—Aug., 1910. No. 17251 F.

Rail Corrugation.

Some Notes on Rail Corrugation. J. H. M. Andrews. Outlines some of the more prominent causes and gives the opinion of the writer based on observation and experiment. 1500 w. Elec Ry Jour—Sept. 3, 1910. No. 16867.

Rail Corrugation. A Busse. Abstract of a report on replies received to questions sent out. Points to the conclusion that the trouble is due to the rail metal or to peculiarities caused by the method of rolling. 3500 w. Elect'n, Lond—Sept. 16, 1910. No. 17429 A.

Rail Joints.

Theory of Rail Joints. Felix Lange. Abstract of a paper before the Am. St. & Int. Ry. Assn. Discusses causes of wear and the requirements welded joints must meet. 1200 w. Elec Ry Jour—Oct. 12, 1910. (Daily Ed.) No. 17806.

Railless.

The Mercedes-Stoll Railless Electric Traction System of the Vienna Street Railways (Viermotorige elektrische Oberleitungs-Automobilwagen System "Mercedes-Electrique-Stoll" der Wiener städtischen Strassenbahnen). Arthur Ertel. Brief description of the line and equipment. Ills. 1200 w. Elek Kraft u Bahnen—Aug. 14, 1910. No. 17481 D.

Rails.

History of Street Railway Rails. E. B. Entwistle. Abstract of a paper read before the Cont. Elec. Ry. Assn. Illustrated review of types of rail used. 1200 w. Elec Ry Jour—Sept. 24, 1910. No. 17389.

Shops.

Repair Shops of the Bangor Railway & Electric Company. The extensive shops at Bangor, Maine, are illustrated and described. 2000 w. Elec Ry Jour—Sept. 24, 1910. No. 17388.

Signalling.

Automatic Section Blocking for Electric Haulage Ways or Similar Electric Railway Installations (Selbsttätige Streckenblockung für elektrisch betriebene Förderbahnen oder ähnliche Eisenbahnanlagen). L. Kohlfürst. Describes the Siemens-Schuckert system. Ills. 3000 w. Elek Kraft u Bahnen—Aug. 4, 1910. No. 17478 D.

Single Phase.

A Norwegian Single Phase Railway. Brief illustrated description of the Thamshavn Lokken electric railway. 700 w. Ry Age Gaz—Sept. 2, 1910. No. 16859.

Subways.

Tri-Borough Subway and Elevated System, New York City. Map and description of the proposed system having a total length of 44.21 miles. 1500 w. Eng Rec —Sept. 10, 1910. No. 17046.

Subway Stations.

Construction of the Rue de Crimée Station on the Paris Metropolitan (Note sur l'Exécution de la Station du Chemin de Fer Métropolitain de Paris "Rue de Crimée"). M. Suquet. Describes the design of a subway station to meet special and difficult conditions. Ills. 2500 w. Ann d Ponts et Chaussées—1910-IV No. 17206 E + F.

Types of Subway Stations on the North-South Railway in Paris (Note sur divers Types du Stations souterraines établies dans les Voies étroites pour le Chemin de Fer Nord-Sud de Paris). M. Bechmann. Describes four types of stations on single-track lines. Ills. 6000 w. Ann d Ponts et Chaussées—1910-IV. No. 17205 E + F.

Supplies.

Ordering and Standardization of Supplies on the London County Council Tramways. Describes the catalogues prepared to overcome the uncertain methods of describing supplies. 1000 w. Elec Ry Jour—Sept. 3, 1910. No. 16866.

Track Maintenance.

The Economical Maintenance of Tracks and Roadways. Martin Schreiber. Abstract of paper read before the Am. St. & Int. Ry. Assn. Discusses some of the more important features of the work, stating conclusions. Ills. 3000 w. Elec Ry Jour—Oct. 12, 1910. (Daily Ed.) No. 17807.

Track Deflection.

A Study of Track Deflection and Materials. Information from the annual report of the Board of Supervising Engineers of Chicago Traction. 1500 w. Elec Ry Jour—Oct. 8, 1910. No. 17738.

Traffic.

Traffic Promotion in New England. Illustrated report of methods found successful. 8500 w. Elec Ry Jour—Oct. 8, 1910. (Convention No.) No. 17739.

Traffic Promotion in Central New York and Atlantic Coast States. Illustrated report of methods, equipment, etc. 13500 w. Elec Ry Jour—Oct. 8, 1910. (Convention No.) No. 17740.

Traffic Methods of Electric Railways in Ohio, Indiana and Michigan. Describes successful promotion methods, illustrating stations, etc. 24000 w. Elec Ry Jour—Oct. 8, 1910. (Convention No.) No. 17741.

Traffic Work on Electric Railways in the Mississippi Valley. An illustrated article describing organization, advertising methods, equipment, stations, etc. 13000 w. Elec Ry Jour—Oct. 8, 1910. (Convention No.) No. 17742.

Traffic Features of Some of the Pacific Coast Roads. An illustrated account of the terminals, equipment, methods, etc. 7500 w. Elec Ry Jour—Oct. 8, 1910. (Convention No.) No. 17743.

Train Dispatching.

Telephone Dispatching and Train-Order Signals for Electric Railways. Editorial on the methods of handling and regulating traffic on electric interurban railways. 1500 w. Eng News—Sept. 29, 1910. No. 17531.

Trolley Lines.

See Insulators, under ELECTRICAL ENGINEERING, TRANSMISSION.

Valuation.

Methods of Conducting the Valuation of the Physical Properties of the Chicago Consolidated Traction Co., with Summaries of Cost. Philip J. Kealy. Describes methods and costs of track and power house valuation. 3500 w. Engng-Con—Sept. 28, 1910. No. 17522.

Methods of Conducting the Valuation of the Physical Properties of the Chicago Consolidated Traction Co., with Summaries of Costs. Philip J. Kealy. Gives data of the distribution system. 1500 w. Engng-Con—Oct. 5, 1910. No. 17705.

Valuation of the Track of the Detroit Street Railway System. Explains methods used in track valuation, including 21 types of rail sections. 1500 w. Eng News—Sept. 8, 1910. No. 17001.

The Valuation of the Detroit Street Railways. An explanation of the situation, with comparison of valuations made for the city, with those made for the company. 4000 w. Eng News—Aug. 25, 1910. No. 16634.

Wheels.

The Wear of Wheels. J. A. O'Brien. A discussion of flange wear in rail vehicles. 1400 w. Elec Rev, Lond—Aug. 26, 1910. No. 16942 A.

EXPLANATORY NOTE—THE ENGINEERING INDEX

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language,* together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cts. The letter A, B, or C denotes a price of 40 cts.; D, of 60 cts.; E, of 80 cts.; F, of $1.00; G, of $1.20; H, of $1.60. When the letter N is used it indicates that copies are not readily obtainable and that particulars as to price will be supplied on application. Certain journals, however, make large extra charges for back numbers. In such cases we may have to increase proportionately the normal charge given in the Index. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

Serial publications are indexed on the appearance of the first instalment.

SPECIAL NOTICE.—To avoid the inconvenience of letter-writing and small remittances, especially from foreign countries, and to cheapen the cost of articles to those who order frequently, we sell coupons at the following prices:—20 cts. each or a book of twelve for $2.00; three books for $5.00.

Each coupon will be received by us in payment for any 20-cent article catalogued in the Index. For articles of a higher price, one of these coupons will be received for each 20 cents; thus, a 40-cent article will require two coupons; a 60-cent article, three coupons; and so on. The use of these coupons is strongly commended to our readers. They not only reduce the cost of articles 25 per cent. (from 20c. to 15c.), but they need only a trial to demonstrate their very great convenience—especially to engineers in foreign countries, or away from libraries and technical club facilities.

Write for a sample coupon—free to any part of the world.

CARD INDEX.—These pages are issued separately from the Magazine, printed on one side of the paper only, and in this form they meet the exact requirements of those who desire to clip the items for card-index purposes. Thus printed they are supplied to regular subscribers of THE ENGINEERING MAGAZINE at 10 cents per month, or $1.00 a year; to non-subscribers, 25 cts. per month, or $3.00 a year.

THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the index. In the list below, *w* indicates a weekly publication, *b-w,* a bi-weekly, *s-w,* a semi-weekly, *m,* a monthly, *b-m,* a bi-monthly, *t-m,* a tri-monthly, *qr,* a quarterly, *s-q,* semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated; W—Words; Anon—Anonymous.

Alliance Industrielle. *m.* Brussels.
American Architect. *w.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Jl. of Science. *m.* New Haven, U. S. A.
American Machinist. *w.* New York.
Anales de la Soc. Cien. Argentina. *m.* Buenos Aires.
Annales des Ponts et Chaussées. *m.* Paris.
Ann. d Soc. Ing. d Arch Ital. *s-m.* Rome.
Architect. *w.* London.
Architectural Record. *m.* New York.
Architectural Review. *s-q.* Boston.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Melbourne.
Autocar. *w.* Coventry, England.
Automobile. *w.* New York.
Automotor Journal. *w.* London.
Beton und Eisen. *qr.* Vienna.
Boiler Maker. *m.* New York.
Brass World. *m.* Bridgeport, Conn.
Brickbuilder. *m.* Boston.
Builder. *w.* London.
Bull. Bur. of Standards. *qr.* Washington.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bull. of Can. Min. Inst. *qr.* Montreal.
Bull. Soc. Int. d'Electriciens. *m.* Paris.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bull. Int. Railway Congress. *m.* Brussels.
Bull. Scien. de l'Assn. des Elèves des Ecoles Spéc. *m.* Liége.
Bull. Tech. de la Suisse Romande. *s-m.* Lausanne.
California Jour. of Tech. *m.* Berkeley, Cal.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *w.* Toronto and Montreal.
Canadian Mining Journal. *b-w.* Toronto.
Cassier's Magazine. *m.* New York and London.
Castings. *m.* Cleveland, O.
Cement. *m.* New York.
Cement Age. *m.* New York.
Central Station. *m.* New York.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Colliery Guardian. *w.* London.
Commercial Vehicle. *m.* New York.

Compressed Air. *m.* New York.
Comptes Rendus de l' Acad. des Sciences. *w.* Paris.
Cornell Civil Engineer. *m.* Ithaca.
Deutsche Bauzeitung. *b-w.* Berlin.
Die Turbine. *s-m.* Berlin.
Domestic Engineering. *w.* Chicago.
Economic Geology. *m.* New Haven, Conn.
Electrical Age. *m.* New York.
Electrical Engineer. *m.* London.
Electrical Engineering. *w.* London.
Electrical Review. *w.* London.
Electrical Review. *w.* New York.
Electric Journal. *m.* Pittsburg, Pa.
Electric Railway Journal. *w.* New York.
Electrical World. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.
Elektrische Kraftbetriebe u Bahnen. *w.* Munich.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnik u Maschinenbau. *w.* Vienna.
Elektrotechnische Rundschau. *w.* Potsdam.
Elettricità. *w.* Milan.
Engineer. *w.* London.
Engineering. *w.* London.
Engineering-Contracting. *w.* New York.
Engineering Magazine. *m.* New York and London.
Engineering and Mining Journal. *w.* New York.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penna. *m.* Pittsburg, U. S. A.
Foundry. *m.* Cleveland, U. S. A.
Génie Civil. *w.* Paris.
Giesserei-Zeitung. *s-m.* Berlin.
Glasers Ann. f Gewerbe & Bauwesen. *s-m.* Berlin.
Heating and Ventilating Mag. *m.* New York.
Horseless Age. *w.* New York.
Ice and Cold Storage. *m.* London.
Ice and Refrigeration. *m.* New York.
Il Cemento. *s-m.* Milan.
Industrial World. *w.* Pittsburg.
Ingegneria Ferroviaria. *s-m.* Rome.
Ingenieur. *w.* Hague.
Insurance Engineering. *m.* New York.
Int. Marine Engineering. *m.* New York.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron Trade Review. *w.* Cleveland, U. S. A.
Jour. of Accountancy. *m.* N. Y.
Journal Asso. Eng. Societies. *m.* Philadelphia.
Journal Franklin Institute. *m.* Philadelphia.
Jour. N. E. Water Works Assn. *qr.* Boston.
Journal Royal Inst. of Brit. Arch. *s-q.* London.
Jour. Roy. United Service Inst. *m.* London.
Journal of Sanitary Institute. *qr.* London.
Jour. of South African Assn. of Engineers. *m.* Johannesburg, S. A.
Journal of the Society of Arts. *w.* London.
Jour. Transvaal Inst. of Mech. Engrs., Johannesburg, S. A.
Jour. of U. S. Artillery. *b-m.* Fort Monroe, U. S. A
Jour. W. of Scot. Iron & Steel Inst. *m.* Glasgow.
Journal Western Soc. of Eng. *b-m.* Chicago.
Jour. of Worcester Poly. Inst., Worcester, U. S. A.
Locomotive. *m.* Hartford, U. S. A.
Machinery. *m.* New York.
Manufacturer's Record. *w.* Baltimore.
Marine Review. *m.* Cleveland, U. S. A.
Mechanical Engineer. *w.* London.
Mechanical World. *w.* Manchester.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Metallurgical and Chem. Engng. *m.* New York.
Métallurgie. *w.* Paris.
Metal Worker. *w.* New York.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci. Press. *w.* San Francisco.
Mining Journal. *w.* London.
Mining Magazine. *m.* London.
Mining World. *w.* Chicago.
Mittheilungen des Vereins für die Förderung des Local- und Strassenbahnwesens. *m.* Vienna.
Municipal Engineering. *m.* Indianapolis, U. S. A.
Municipal Journal and Engineer. *w.* New York.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Oest. Wochensch. f. d. Oeff. Baudienst. *w.* Vienna.
Oest. Zeitschr. Berg- & Hüttenwesen. *w.* Vienna.
Plumber and Decorator. *m.* London.
Power and The Engineer. *w.* New York.
Practical Engineer. *w.* London.
Pro. Am. Ins. Electrical Eng. *m.* New York.
Pro. Am. Ins. of Mining Eng. *m.* New York.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Pro. Am. Soc. Mech. Engineers. *m.* New York.
Pro. Canadian Soc. Civ. Engrs. *m.* Montreal.
Proceedings Engineers' Club. *qr.* Philadelphia.
Pro. Engrs. Soc. of Western Pennsylvania. *m.* Pittsburg.
Pro. St. Louis R'way Club. *m.* St. Louis, U. S. A.
Pro. U. S. Naval Inst. *qr.* Annapolis, Md.
Progressive Age. *s-m.* New York.
Public Works. *qr.* London.
Quarry. *m.* London.
Queensland Gov. Mining Jour. *m.* Brisbane, Australia.
Railway Age Gazette. *m.* New York.
Railway and Engineering Review. *w.* Chicago.
Railway and Loc. Engng. *m.* New York.
Railway Master Mechanic. *m.* Chicago.
Revue d'Electrochimie et d'Electrométallurgie. *m.* Paris.
Revue de Mécanique. *m.* Paris.
Revue de Métallurgie. *m.* Paris.
Revue Gén. des Chemins de Fer. *m.* Paris.
Revue Gén. des Sciences. *w.* Paris.
Revue Industrielle. *w.* Paris.
Rivista Marittima. *m.* Rome.
Rudder. *m.* New York.
Schiffbau. *s-m.* Berlin.
School of Mines Quarterly. *q.* New York.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Sibley Jour. of Mech. Eng. *m.* Ithaca, N. Y.
Signal Engineer. *m.* Chicago.
Soc. Belge des Elect'ns. *m.* Brussels.
Stahl und Eisen. *w.* Düsseldorf.
Stevens Institute Indicator. *qr.* Hoboken, U. S. A.
Surveyor. *w.* London.
Technik und Wirtschaft. *m.* Berlin.
Technique Moderne. *m.* Paris.
Tramway & Railway World. *m.* London.
Trans. Inst. of Engrs. & Shipbuilders in Scotland, Glasgow.
Wood Craft. *m.* Cleveland, U. S. A.
Yale Scientific Monthly. *m.* New Haven.
Zeitschr. f. d. Gesamte Turbinenwesen. *w.* Munich.
Zeitschr. d. Mitteleurop. Motorwagen. Ver. *s-m.* Berlin.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschr. f. Werkzeugmaschinen. *b-w.* Berlin,

THE
ENGINEERING MAGAZINE
"THE WORLD IS ITS FIELD"

VOL. XL. DECEMBER, 1910. No. 3.

THE ELECTRIFICATION OF A COMMONWEALTH.

By Sylvester Baxter.

Mr. Baxter presents what might be termed the amiable aspects of industrial centralization, from the viewpoint of appreciation and approval. The manifest fact is that economic forces are compelling a rapid movement toward centralization against which argument or legislation is of little effect. It is therefore an important service to set forth models of high standard—ideals of the best toward which the inevitable progress of the age may be directed. Such ideals and models are set forth in Mr. Baxter's concepts.—THE EDITORS.

POWER, a simple product, is put to complex uses. Industrial efficiency depends upon its well ordered production, distribution, consumption. The supplying of it may be regarded as a water-supply is. A city may best get its water from one common source. In the same way a community may best be supplied with power.

A highly significant example of how power for all industrial uses may be supplied from one central source, thereby affecting the economic organization of a whole State, is now presented in Connecticut. In no other State of the Union has the principle been so comprehensively applied—primarily to transportation; prospectively with regard to all demands for mechanical energy that may arise. The railway system—that is, the primary, or steam-line, service of the great transportation company that serves Connecticut in common with nearly all New England—stands at the threshold of electrification. Certain fortunate circumstances have prepared the way for the extension of its advantages in the efficient generation of motive power to collateral activities of various kinds. A striking sagacity and foresight in a survey of the economic horizon has been a guiding factor in establishing these singularly favorable conditions.

In the more populous sections a secondary system complementing the primary lines has been realized. Hence the same transportation company now owns the greater portion of the trolley lines, or street railways. These are never real competitors of the primary lines except in a minor and inconsiderable degree. Their function is essentially auxiliary. The street-railways are natural feeders of the primary lines. Two separate systems cannot well serve the same community without wasteful duplications.

Again, in the territory served by one general transportation system various other "natural monopolies" of a minor character, or rather of a more limited scope, also operate. Beside the local transportation services there are the water-supplies and the gas and electric plants for lighting, heat, and power. The great railway systems took shape by absorbing a multiplicity of short local lines for the organization of main routes of general traffic. In like manner all these local services tend to achieve a wider radius, extending their respective fields from within the bounds of single municipalities towards clusters of adjacent municipalities and even to groups of such clusters.

Street railways are no longer isolated local undertakings. One organization serves not only one urban cluster; through interurban lines its field comprises extensive groups of such clusters. In the same way all the municipalities in a given cluster are served in common by the same electric-lighting and power company, or gas company. Notable economies may be effected by associating many such companies under one central management. Supplies for the entire group may be purchased on a large scale and with corresponding economy. Better administrative and engineering talent may be obtained, with general officials and experts of the highest capacity in the service of all the companies, instead of separate sets of cheap and inferior men for each local concern. The course of "natural monopoly" is therefore towards the organization of larger units. These units tend to include not only all services of a similar nature, but all services that may depend upon a common form of energy or source of supply. Theoretically there appears to be no limit to this unifying tendency; in practice we see a steadily increasing realization of the principle.

In the specific instance here discussed the primary impulse in this momentous process was imparted by no deliberate initiative, no conscious planning of highly organized industrial activities from the ground up. It has been more like a natural evolution than a deliberately planned development. This seems the more remarkable in view of the circumstance that the process, as it advances, bears more and more the evidences of intelligent direction, of masterly leadership, But it is the leadership that understands how to take a wise advantage of existing currents and tendencies of economics and industrial evolutions and shapes its course accordingly—much as the skilled aeronaut of today, by his knowledge of the directions of air currents in different latitudes and at different heights, might guide his balloon to some chosen destination beyond the Atlantic. The original impulse dates far back to the tendencies that grew out of the beginnings of the modern movements in transportation, manufacturing, and communication. All the concentration of mechanical energy and of capital, the combinations, the consolidations, the creation of larger units, the perfecting of organization on a colossal scale, thus became inevitable. The disposition to oppose, to obstruct, to prevent, these consummations is as futile as were the earlier struggles of handworkers against the introduction of the machinery that they feared was to deprive them of their livelihood.

In Connecticut the ground had been well prepared for the larger shaping of things. Sagacious minds perceived the possibilities resident in economic circumstance and proceeded to realize them. Back in the horse-car days it was not uncommon for a relatively small city to have two or more competitive street-railway companies. The consolidating tendency had at first a purely local scope. With electrification the connection of neighboring communities by interurban lines was a natural consequence, followed by consolidations of the local systems thus brought together. In Connecticut the organization of a general street-railway system for the entire State had thus been well advanced when the management of the great corporation that controls the primary railway service became alive to the desirability of a unified ownership of the primary and secondary lines. The consolidated trolley-lines were accordingly taken over.

It chanced that some of the local street-railway companies that had been acquired supplied the communities where they operated with electricity for light and power purposes. In certain instances the same companies also owned the local gas-works. Other local street-railway companies derived their electricity from water-powers of considerable magnitude, and some of these companies furnished the water-supply for the municipalities. Hence we see not only the transportation services of the State, both primary and secondary, controlled for the greater part by one corporation, but subsidiary thereto, to a considerable extent, the local supplies of light, heat, water and power.

We have seen that these functions were only incidental to the main business of transportation. It might perhaps be represented that there was no more reason why a great transportation undertaking should administer these services than for it to enter upon any other commercial enterprise, such as selling groceries, for instance. Still, these extra functions are of the sort commonly recognized as public services. For good reasons they were performed by the local street-railway companies. For instance, since they had the capacity to generate more electricity than they required for their own uses they could profitably sell the surplus to the public. This enabled them to operate more economically and thereby serve the public with transportation to better advantage. Other companies whose electricity was generated from water-power found that with their surplus power they could economically pump water and supply it to cities and towns. Again, it has proved profitable in certain instances to supply gas in connection with the local transit service. Possibly the same gas may be economically utilized in internal-combustion engines for generating electric power. These functions had all been profitable to the local companies under the old conditions. In the economical disposition of surplus products or surplus energy they were legitimate adjuncts to their regular business. When the great transportation company acquired the street-railway properties these incidental functions continued profitable as before. But since the instances were few in number they formed inconsiderable items in the grand total of revenue-producing agencies. Had it been a question of organizing a comprehensive scheme anew, from the ground up, it might never have occurred to the management to assume the various subsidiary functions thus involved. But since the legislation whereby the street-railways were taken over had empowered the parent company to undertake generally all the activities previously exercised in special instances, it was led to consider the possibilities of a broad scheme of development that should include systematically organized operations of that sort.

In building up so complex a structure the material employed has naturally affected its shape very notably. In successive stages of acquisition smaller companies have been overlaid with greater ones until all have become elements in one great central corporation. In this way the ownership and operation of the street-railway properties now resides in a corporation known as the Connecticut Company. All the stock in this corporation is held by the parent railroad company, the New York, New Haven & Hartford. There is thus a distinction in function without a difference in actual proprietorship. For accounting and operating purposes the subsidiary corporation is a great administrative convenience. Street-railway practice differs in important respects from steam-railway practice. Even with the electrification of the steam lines the difference must continue. The Connecticut Company has therefore a wholly distinct organization and a wholly different staff, responsible only to the executive of the parent company. While its operations are thus quite independent of the primary service they are co-ordinated wherever desirable. All this makes for the efficiency that experience shows is one of the results of modern operations on a large scale. It has been charged that vast corporate undertakings tend to become cumbersome and correspondingly inefficient. It is doubtful if any substantial basis for this assumption can be found when the unit principle of operation, as in the aforesaid instance, is adopted. Huge organizations like the Pennsylvania, the Southern Railway, and the Harriman systems attest the contrary.

This common ownership of primary and secondary railway systems makes possible a most admirable flexibility in operation. In nearly all the older parts of the country the haphazard building of unrelated pieces of independent lines in the same territory, eventually absorbed by a common interest, has led to the retention of much superfluous trackage. A most eminent authority has pointed out that were New England to be provided with an entirely new railway system a vastly superior service might be given with a reduction of the existing trackage by at least one-third. The waste from such unnecessary construction, perpetuated in operating and maintenance charges, is prodigious. It entails a corresponding burden upon the public.

In Connecticut the problem of utilizing some of this superfluous trackage has been solved by electrifying it and transferring it to the Connecticut Company for operation on trolley-line principles. At night the local freight service is performed by the steam-line organization. In developing a trolley service in the same territory as the steam line it is occasionally found desirable to build a new trolley line parallel with the steam tracks. The company apparently thus competes with itself. But the conditions of service and operation are so different that in reality the parallel trolley line is an auxiliary, a feeder, rather than a competitor in any true sense.

Again, unnecessary duplications are thus avoided. For example, the trolley-cars start from the railway station of a certain busy manufacturing city and enter upon an electrified old steam line that had been next to abandoned—previously operated only because the law required it—and at another city they again enter upon the streets and proceed to the business center. Here other trolley cars run to the station and enter upon other steam tracks, electrified for a couple of miles, thereby saving that much parallel construction. Departing from the steam tracks, the trolley service runs over a new interurban line, substantially built according to steam-line principles. This line cuts across country by its own right of way, returning at intervals to the highways for the sake of passing through towns and villages. Entering the capital city of the State, the cars traverse the business center and cross the Connecticut over a noble commemorative bridge of granite, lately built. Here another interurban line continues the service; its trolley cars proceed to the station and there enter upon the steam-car tracks—this time those of one of the great double-track main lines of the system with an extensive traffic of its own in both passengers and freight. For some miles this main line has been electrified; the trolley cars stop only at the regular stations, but fares are charged according to the five-cent zone principle of electric-railway practice. At the first junction point the trolley cars pass from the main line onto an electrified branch of the steam system to an important mill-town; here they take to the streets and thence run across the hills by a long interurban line to an attractive country town of considerable importance.

The economy of this procedure is manifest. Common ownership of steam lines and trolleys has made it possible to utilize long stretches of the primary system also for the secondary service. Otherwise there would have been costly duplications, or, owing to the expense, there might have been attempted no secondary service at all. By thus averting outlays mounting into many hundreds of thousands, money has been saved for other improvements demanded by the public interest. In this connection it may be noted that an interurban line between Worcester in Massachusetts and Hartford in Connecticut had been planned. A portion of the trolley route above mentioned was to be utilized for the purpose. Massachusetts and Connecticut, in common with the other New England States, are served by the same great railway system. The general transportation conditions in the two States are as similar as in two adjacent counties served by the same railway. But the legal requirements so differ as to demand quite different methods in operation. The rigidity of Massachusetts law forbids ownership of trolley lines by a steam-railway company, unless by special dispensation. Hence there is a corresponding inflexibility of relationship between the primary and secondary systems. So long as this inhibition lasts, so long will it be impracticable to realize the much desired interurban route aforementioned. Trolley-line development has been correspondingly arrested in Massachusetts in recent years; lines that might be profitably undertaken by a great railway corporation, with its command of large resources and its incentive to encourage local development in order to build up its territory and create new business for its primary service, are otherwise not attractive for capital.

The waste entailed by needless duplications in the way of parallel primary and secondary lines made necessary under Massachusetts restrictions is strikingly illustrated in the Greater Boston region. Trolley-line competition had made certain suburban branches of the steam lines unprofitable. The great company that controls the local-transit service has projected costly extensions of its rapid-transit system to the important suburbs, Malden and Medford. Under a common ownership of the primary and secondary systems the unprofitable branches to these suburbs might be used in connection with the latter service to mutual advantage, thus saving for other needed improvements the millions that otherwise will be called for by these extensions.

The foregoing glance at results in Connecticut indicates what may be expected in the way of public convenience and economy when manifold forms of service are permitted to draw their energy from a common source of supply. Years must go by before the ends aimed at in the Connecticut programme are fully realized. Yet when we recall what has been accomplished in the generation that has passed since electric lighting and power-development became commercially practicable, it is hardly too much to expect that before the next generation has half run its course the ends now planned for will be fully achieved.

Not so much for contrast as for comparison may a glance here be taken at conditions in a neighboring commonwealth that bear upon the same problems. The tendencies, the forces, at work to these ends are of course universal in their operation. Everywhere throughout our modern civilization they must in some way find expression. In Connecticut conditions are more prepared for such consummations than elsewhere in the United States. Massachusetts is one of the greatest of American industrial States. In its political, economic and social fabric it ranks as one of the most advanced and highly organized of communities. In its economic development and in its legislation, it has, as a whole, promoted the tendencies that in the policy of Connecticut have found so complete an expression.

For example, through nearly a half century it has been a settled policy in Massachusetts to encourage the consolidation of railway lines. The public authorities have gone so far as to urge consolidation upon unwilling corporations. Year after year the Board of Railroad Commissioners recommended that the two parallel lines, the

Boston & Maine and the Eastern, cease a destructive competition and come together. As a logical outcome of this policy nearly every steam-railway line in Massachusetts has come under a common ownership and management. There are only two important exceptions to this rule, and one is a branch of a great foreign system that incidentally crosses the State. Like tendencies have shaped the development of trolley lines. While street railways perform an essentially local service, there are now no strictly local street-railway systems in Massachusetts. The three or four great groups that divide the field seem destined to merge.

Yet in more recent Massachusetts legislation—perhaps in reflection of the curious illogical spirit that in federal legislation imposes condition which make competition impossible and in the next breath insists upon competition—there has been a disposition to surround each separate public-service function with strict lines of demarcation and confine its operations to its own particular bin, regardless of possibly very natural relations that might be established with its fellows and neighbors of other sorts. Hence under the law steam railways may have nothing to do with street railways, and neither steam railways nor street railways may acquire interest in the interurban lines termed "electric railroads" in local legislation parlance. All this rigidity in classification concerns three grades of railway practice that by nature have much in common. With the impending electrification of steam lines the convergence must increase. Yet for the time being there is a tendency to foster the very sort of competition among these differently classified varieties of transportation that public policy has discouraged when exerted within one class. All this makes impracticable the very desirable flexibility in operation that, as we have seen, is induced by the unification of primary and secondary services under a common control.

In other forms of public utilities the same rigid classification appears. Electric-light and power companies must keep apart from gas companies. An electric-light and power company may sell current for street-railway purposes, but no electric-railway company may sell its current for lighting and power purposes. Yet when artificial obstacles are interposed against the operation of world-wide economic tendencies that practically have the force of natural law, human ingenuity may be counted upon to find some way of overcoming them. In the case of gas and electric companies it takes the form of a trusteeship. The stock of numerous lighting companies is acquired, placed in the hands of trustees, and new stock is issued against their holdings. Marked economies and improvements are thus effected.

Another restrictive tendency in Massachusetts hampers the free operation of public-service corporations by laying down rules of conduct in internal administration that largely deprive them of the power of initiative desirable both in their own interest and that of the public. For instance, the great transportation company that serves nearly all New England, finding that its territory was threatened with a large and probably permanent increase in rates on anthracite, managed by an admirable stroke to secure control of one of the important anthracite railways. New England was thus securely protected against what would have severely taxed her domestic and industrial resources. But it was charged that this action, though so clearly in the interest of Massachusetts, was in violation of Massachusetts law; that while permitted by the company's Connecticut charter it was not permissible under its Massachusetts charter; that before securing control of the property in question the company should have come to the Massachusetts authorities for permission! Publicity, of course, not to mention the long delay, would have made the move impossible. Suppose a hunter, for each particular shot he desired to take, were required to go and obtain written permission from the game warden!

The various restrictions upon public-service undertakings imposed by Massachusetts law have thus tended more and more to obstruct the path of consistent development. In navigable waters we often see a series of stakes and beacons so set as to mark a safe channel across shallow places. But if these safeguards are set too close they may gather about them drifting sands and sediment, creating new shoals to imperil navigation. So, while aiming to prevent encroachments and interferences on the part of undertakings entrusted with the exercise of various public services, these restrictions tend to impede the efficiency of the services themselves.

The dread of monopoly and its possible abuses is natural. Unrestrained monopoly is something that may well be feared. But should we attempt to impede economic and industrial progress for fear that new conditions incidental to progress may make it possible for undesirable things to happen? Rather is it not the way of wisdom to prepare the freest possible road for the course of progress and at the same time, or as occasion may arise, to provide regulations that will direct in the right channels for the public good the unified and well co-ordinated activities that modern progress implies? Recent economic history indicates that there is little ground for the fear that monopolies may become so powerful as to direct the conduct of governments. On the contrary, the more effective the tendency to monopoly the more practicable becomes its regulation. Corruptive pressure upon legislation was much greater in the days when hosts of minor competitive interests swarmed in legislative lobbies. To urge that public-service monopolies, although desirable for the sake of efficiency, should nevertheless be discouraged and forbidden, for the reason that they might exert so dangerous an influence upon government that it would be impossible to regulate them, implies a fundamental distrust of popular government. If a government cannot effectively regulate the conduct of a monopoly, is there any reason to expect that it can any better be trusted to regulate the more complicated conduct of manifold conflicting interests?

An efficient co-ordination of public-service functions should be the next great forward step in the economic world. Significant in this connection is the circumstance that the first decade of the twentieth century is marked by the development of the new technical calling, production engineering." Production engineers have worked wonders in promoting the efficiency of individual industries and of commercial or mercantile activities. The co-ordination of operations within a given enterprise, say a great factory or department store, is one of the chief factors in such work. It is particularly notable that production engineers have effected great economies in the workings of certain bureaus or department divisions in the national government at Washington. A sign of the times is the new appreciation of efficiency in connection with governmental operations—as witnessed by the favor with which the proposition for the appoinment of a permanent Director of Posts, or general manager of the postoffice department, with a possibility of saving many millions a year in the conduct of the service by the adoption of up-to-date business methods, is now looked upon among congressmen.

True economy will come with wise expenditure. Liberal expenditure, when well directed, begets liberal returns. Hence there is an immense field for production engineering in governmental service—national, state and municipal. And just as in the conduct of a city great efficiency can be achieved by thoroughly co-ordinating the operations of individual departments and introducing the spirit of team work among them, so not only in the public-service industries of city, State or nation are there immense possibilities in the ways that we have been considering, but ultimately in the establishment of economical and scientific interrelations among all the diverse factors of trade, communication, productive industry and finance. It is along such lines that the twentieth century seems destined to work out the great problems of efficiency and conservation that, broadly considered, comprise the most vital elements of human wellbeing and progress.

THE ECONOMICS OF FACTORY VENTILATION.

By Royce W. Gilbert.

Ventilation has been actively discussed as a mechanical function. Its foundational data have been defined and its apparatus reviewed very thoroughly, this aspect of the problem having been clearly surveyed by Mr. P. R. Moses in these pages only three months ago.

Mr. Gilbert presents the matter in a new light—that of efficiency. His argument is the increased output—the decreased cost of production—that results from the higher efficiency of workers when proper ventilation is provided. The proposition is advanced here broadly, or with only general quantitative data, with the hope of returning to the subject later in a more conclusive and technical study.—The Editors.

WEBSTER'S definition of the word ventilation is "to air" or "to replace foul air by fresh." In actual practice, however, ventilation should mean more than this. It should mean the conditioning of the air of any enclosed space to the best requirements, of the occupants of that space. In fulfilling these requirements, the practice should embrace the heating of air in winter, the cooling of air in summer, the moistening of too dry air, and the drying of too moist air, the exclusion of dust, odors, fumes, gases, and microscopic life.

As people and machines tend to produce certain injurious elements, provision must be made to carry away the waste as rapidly as it is produced. People, in common with all warm-blooded animals, require a certain amount of oxygen in the air they breathe. To fulfill these two requirements the engineer has adapted the method of change of air as the simplest. To say that this is the cheapest and final method is to jump at an unproved conclusion. So important has this change of air become, however, in the minds of many engineers that it has usurped the place of ventilation in the broader sense, and in the ordinary engineer's vocabulary the term is adopted in this exclusive sense. This misguiding of thought and effort into a rut, as well as the lack of realization of the modern effective incentive—economy—has delayed the progress of this branch of sanitation and kept it behind that of water supply and sewage disposal.

There are three incentives to the progress of ventilation today, which I will consider briefly in turn. First is that of better health for the people (who will not pay for it). This incentive depends for its strength chiefly on the latent sense of social obligation in the man or men who furnish the capital for a public building or work place. The air of our churches, street, and railway cars, shows plainly the ineffectiveness of this incentive.

The second incentive is that of comfort (which the people are ready to pay for). This incentive is especially strong in America, where people pay more and are ready to pay more for comfort than the people of any other land. That the average American fully believes and practices the philosophy of "a short life but a merry one" is more than self-evident—it fairly obtrudes itself. The adoption of this theory is, however, not the intelligent adoption of a life philosophy, but merely the unthinking and most natural trend of a great population in a new country, with an unstable social scale and a general advancement in social rank.

To this general advancement and its necessarily insatiate demand for great profits, we owe the past decades of unthinking exploitation, of wasteful processes and uneconomic manufacturing. Now that we as a people have been suddenly jolted into a realization of our crude and expensive system of economics, and to the need for conservation, the persistent demand for an increasing income has led us to an almost abrupt about-face in our economics of production. Today the thoughtful manufacturer or the wise capitalist knows that economy in production may mean bigger dividends than increase of capacity. In the modern factory, money saved is indeed money earned, and the chances of earning money in this way in our industrial life today are just as numerous as were ever the chances in increased production and market creation of the past fifty years. An increased output usually has to await an increased market. Decreased cost of production means immediate profit.

To this realization of a potential source of income, and to the fact that labor is the most expensive item in the machine of modern production, we owe the third incentive to good ventilation—namely, increased efficiency of labor, which means actual saving of money and therefore increased dividends. I believe the time is not far off when our mills and factories will be the most perfectly ventilated buildings that we will have. The American producer is too desirous of the above mentioned increase in dividends to neglect for long a business opportunity with such sure and bounteous returns as increased efficiency of labor offers.

This consideration leads us back to the first incentive, health. In this the mass of the people and eventually the State will recognize the present overwhelming loss of life and efficiency, and we will all be required to live strictly healthful lives, in accordance with the sanitary rules of most progressive science. When that time comes, health will be the great incentive to ventilation as to all other sanitary work. The thousand must see clearly, however, before the million—hence our greatest present incentive—economy of production.

It is needless to speak of the present ordinary efficiency of indoor workers. Every foreman, every superintendent, even the workers themselves know how low it is. They know the "eleven o'clock fag" and the listless waiting for the five o'clock whistle. The money loss of this low efficiency is too obvious to need any amount of elaboration. Savings are usually recorded in percentage of cost of the total item. If 10 per cent is saved in a year in any important item of production cost, the superintendent is certainly to be congratulated. If the 50 per cent efficiency of the average factory worker can be raised to 75 per cent at a cost of 5 per cent of the total payroll (for interest on the cost of a ventilating system, replacement fund, and operation) is the question not worth serious attention?

Suppose a shoe factory to employ two hundred operatives. The yearly payroll will be about $75,000. A 25 per cent increase in efficiency would mean $18,750 worth more work. Five per cent of $75,000 ($3,750), would pay 5 per cent interest, 5 per cent replacement, and 5 per cent operation charges on a $25,000 ventilating plant. Such a system would in general be sufficient for a two-hundred operative factory. The net annual profit would be $15,000.

Some processes require fresh air, and in these the efficiency of the workers should be high though not necessarily as high as proper ventilation can raise it, for the simple reason that "fresh" air is not always the same and at times it may not be best suited to the needs of the workers.

In other industrial plants, such as cotton mills, a warm, humid, air must be employed in order to protect the quality of the product. In such plants, the labor efficiency will be low and allowance must be made for the fact.

Some factories say that piece work eliminates the efficiency factor altogether. If machines are used, however, it is readily seen that as the value of a machine depends upon its output, it is much cheaper to provide the simple machinery usually adequate for ventilating purposes, than it is to provide 10 to 25 per cent more of the complicated machinery of most factory work.

No matter what the nature of the work, mental, physical, or merely mechanical, if the air the worker breathes and is surrounded by is not suited to his body or his task, an improvement in that air is bound to make for increased efficiency. Ventilation alone may not bring the average 50 per cent worker up to his full efficiency, but it should account for 25 per cent. The other 25 per cent may most likely be lost in unsuitable home environment, and however desirable improvement in the home environment of the worker may be, the shifting condition of labor in most localities makes any improvement approaching the ideal, by factory or mill owner, a very doubtful investment from the standpoint of cold cash.

Many superintendents and owners are still in doubt as to the advisability of investment in ventilating equipment which they fear will not prove satisfactory. They may be influenced by personal experience with ventilating systems that have failed to ventilate, or they may on general principles consider ventilating engineers as very superfluous persons indeed. Some are. Modern engineers however who approach the subject from the sanitary side, and consider the effect on the occupants of a room as well as the purely mechanical problem of moving a certain quantity of air into the room, prove themselves very valuable additions to the consulting staff of any industrial establishment.

I will not trench on Mr. Moses' able articles which recently appeared in this publication, as far as the mechanical methods of securing results are concerned, for I consider that he covered the field in an exceptionally comprehensive manner. I would like to mention however some of the elements to be considered when formulating desired results.

The movement of air may be regarded in general entirely from the standpoint of removal of waste. If all wastes of people or processes are removed by air carriage as soon as produced, no care need be taken for the sufficient supply of oxygen. If however no dusts or fumes are produced, the moisture is absorbed or precipitated, the heat is absorbed, and the odors oxidised (most common odors are oxidised by ozone), then a movement of air into the room may still be necessary in order to supply the requisite amount of oxygen. The presence of carbon dioxide alone even to the extent of 25 to 30 parts will not be injurious or noticeable. The gas itself has no noticeable effect, with low temperature and humidity, till it is present in much larger quantities than ever occur even in rooms with no devised system of change of air. The constant passage of air as well as the natural diffusion of the gas, through walls, around windows, etc., keeps the carbon dioxide content to below 50 parts per 10,000. Of course in actual practice 10 to 15 parts per 10,000 is the allowable limit, on the supposition that the gas is an index to other vitiating elements.

High humidity and temperature (causing interference with the natural dissipation of body heat), unpleasant odors, fumes, dust, and bacteria or moulds, are the causes of low efficiency. Microscopic organisms are always dangerous. Wherever dust is present, to act as carriers for the germs, there is always danger from colds and minor affections that often cause loss of time or decreased efficiency, and very often there is danger from specific lung and throat diseases. The practical elimination of dust would practically dispel the danger from germs. If dust cannot be entirely eliminated it can at least be minimized in quantity, in any process. Dust in itself appears to be merely irritating, but irritation of the eyes, throat, mucous membrane, and lungs, causes a lowering of resistance to pathogenic germs. This lowering of resistance means simply a lowering of body efficiency which of course means working efficiency.

Odors, gases, and fumes, are to be distinguished from one another. Fumes are the visible air-carried products of certain chemical reactions, and are nearly always directly injurious to health. Gases may be directly injurious or merely irritating. Odors are seldom directly injurious, merely unpleasant and irritating; minor contributors to inefficiency. The foregoing are all elements to be avoided. The *ideal* to be worked for should always be their complete absence in the air of any working place.

Temperature and humidity are not impurities. The *presence* of each is essential; their *limits* however must be carefully regulated. It is here that the study of individual factory conditions is most necessary to satisfactory air supply. Disregarding those industries where the air must be conditioned to suit the article of manufacture, the temperature and humidity must be regulated, in accordance with the requirements of each special class of worker, and each special class of work. There is reason to believe that laborers coming from Southern Europe, accustomed to warm, humid climates, are less affected by such conditions as are imposed by the great cotton mills of Massachusetts than are those from Northern Europe, accustomed to cooler, dryer air. Male workers sometimes require a different quality of air from that suited to female workers. Nature of operation makes a great difference in the optimum quality of the air. Not only the operations requiring a considerable amount of physical exercise, but even those in which the operator stands, require for the best results a slightly lower temperature and humidity than do those in which the operator sits.

Clerks or bookkeepers apparently require slightly more rapid heat removal than do persons engaged in work consisting of purely mechanical movement, with little brain effort.

To attain the desired results after they have been formulated, the nature of the walls, floors, machinery, and article of manufacture must be considered as to their effect on the amount of moisture in the air. They may be absorbent, or condensing, or practically neutral. Their absorption and retention of heat must also be considered. The shape of the space under consideration, baffles, or obstacles to air movement, such as machines, furniture, etc., must be taken into account. Air should never be allowed to stagnate as stagnant air apparently never has the feeling of freshness of air in motion, and hence is not so suitable for workers.

In most instances a relative humidity of 60 to 70 per cent and a temperature of 65 to 70 degrees represent the conditions favorable to the highest efficiency. Where it is not possible to reach this limit other conditions must be made to comply with requirements for *comfort* of the workers, for after all, *comfort* is the best index to efficiency-producing conditions.

All these elements entering into the problem of ventilating for efficiency make the subject one in which careful thought and study covering each individual factory or work place is essential. The original plans should show the results of this study. The ventilating engineer's work, however, is not as a rule completed upon the completion of the plans or even of the plant. To give satisfaction the plant *must* be inspected at frequent intervals. When alterations are made in the use of a room, when the number of regular occupants is increased, or when the amount or kind of machinery is changed, the engineer *must* be consulted if the ventilation is to remain as he designed it.

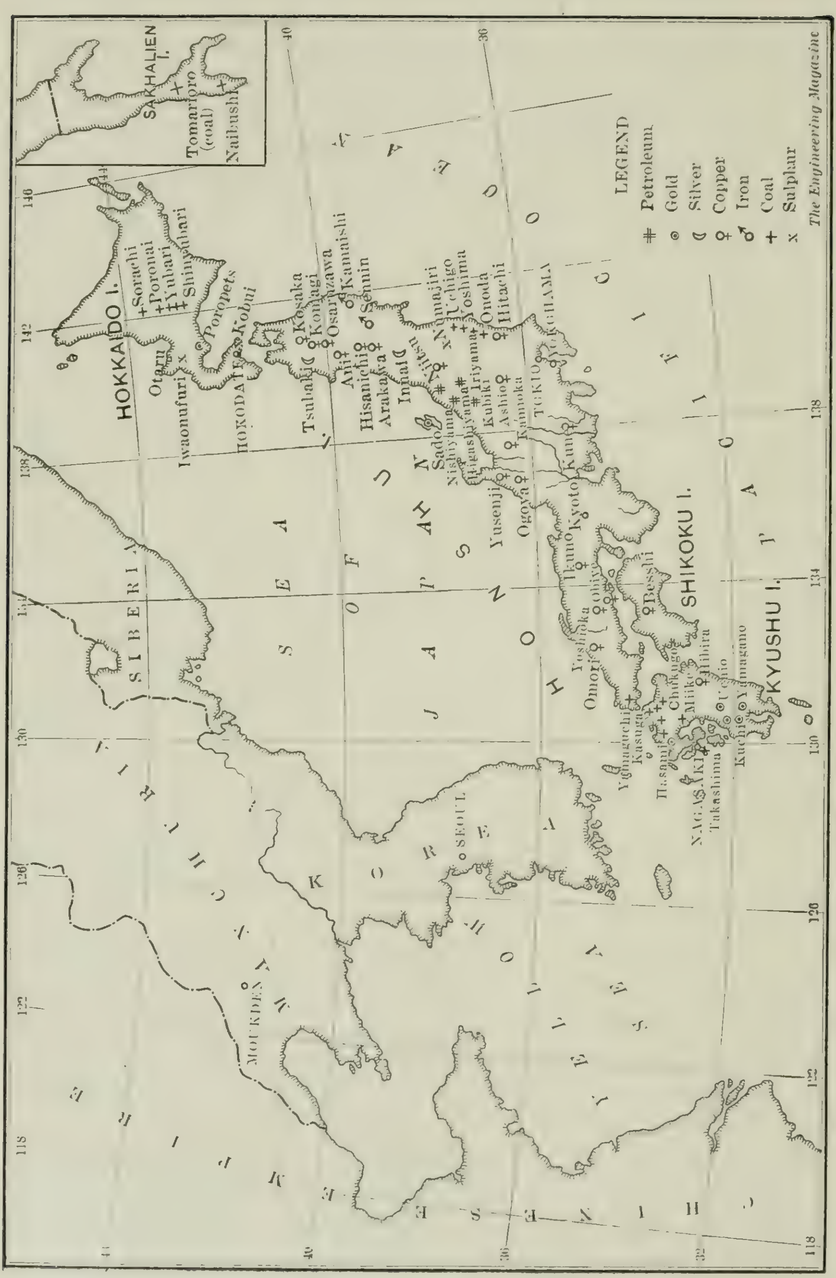
Neglect is the most frequent cause of the failure of ventilating plants to ventilate. The fans may run and not furnish the desired quantity of air, the desired quantity may circulate but not be kept at the desired quality. A very common example of neglect is the overheating of rooms and the heating of rooms when they are not in use. I have found buildings where the temperature as shown by recording thermometers went as high as 90 degrees during the night. Such cases as this are not infrequent and are a pure waste of fuel even when the overheating does not come in working hours and cause a loss of efficiency in addition. In one building, recently, I found that the engineer was in the habit of leaving open a door between the boiler room and the fan room. He was also in the habit of blowing his valves in the boiler room, with the result that nearly saturated air was often supplied to the building, often causing great discomfort to the occupants. The average engineer of a building *will not* pay to the ventilating plant the attention he pays to his engines and other machinery. He regards it as more or less of a useless or perhaps an automatic device. Even though it were possible to build a truly automatic system, it would not be possible to build one that would run year in and year out with the slight attention usually bestowed on such a system. Neither could it be built absolutely fool-proof.

The superintendent or manager cannot always give the matter his personal attention, and as a result a properly designed and installed system may be classed as a failure, a few years—or a few months even, in some cases—after its installation. I have known of instances where the plant was *never* run as designed, from the beginning, on account of some prejudice of the operating engineer.

The only insurance adequate to the situation and satisfying to the superintendent and to the designer which I have found is the use of recording thermometers and hygrometers, located at stragetic points of the ventilating system. These instruments, provided with weekly charts, show plainly the daily and hourly condition of the air with respect to what are perhaps the two most important considerations of the effect on labor efficiency. The charts should be filed with the manager or superintendent and so form an accurate index to the quality of air supplied at all times of the year. They enable the designer to keep in touch with the working of his system and enable him to locate trouble readily. To the superintendent the charts are the means of checking up his engine-room force, as well as his means of knowing whether or not his owners got what they paid for in their ventilating system.

The whole question of industrial ventilation is intricate and worthy of the very serious and careful consideration of experts. That consideration being given, however, the resultant effect of the quality of air supplied by the evolved system is *bound* to mean *money—lessening of expense of production, bigger dividends*—to say nothing of more contended labor, which today is a factor of no mean importance in any industrial centre.

There is no compelling force in our modern life so strong as money, the increase in philanthropy and humanitarianism notwithstanding. Once it is clearly understood that well ventilated work places mean *money,* and ill ventilated work places mean *loss of money,* to the owners—then, and not till then, may we be sure that the day of sweat shop and stuffy factory is over, once and for all.



SKETCH MAP OF THE JAPANESE EMPIRE SHOWING THE PRINCIPAL MINERAL DEPOSITS.

MINERAL RESOURCES OF THE JAPANESE EMPIRE.

By Dr. A. Selwyn-Brown.

In two articles based upon official and authoritative data, Dr. Selwyn-Brown reviews comprehensively the present state and economic future of the mineral industries of Japan. This first part covers general conditions, mining law, methods and machinery, copper, and gold. A second part will deal with coal, iron, lead, zinc, and minor minerals. In view of Japan's manifest purpose and destiny as an oriental industrial power, this summary of basic resources is highly important. We are indebted to the courtesy of the Oriental Information Agency and the Allis-Chalmers Company for illustrations accompanying Dr. Selwyn-Brown's text.—THE EDITORS.

THE wonderful progress that Japan has made in the past forty years in developing her resources is due, in a very large measure, to the foresight and initiative of the Government. By means of a splendid educational policy and unique methods of finance, the Government has assisted the business men of the empire to extend its commerce in every possible manner. The result is that since 1874 statistics covering every phase of national activity exhibit a steady annual growth.

Japanese foreign trade in 1874 was valued at $21,400,000. Last year it amounted to over $500,000,000. Banking transactions, taxation returns and other financial records show a similar growth.

In addition to attending to the development of existing industries, the Japanese Government is always systematically searching for new openings for the energies of its people. Japanese experts are continually traveling around the world obtaining information and instruction, and seeking new methods for the extension of Japanese commerce and the exploitation of the Empire's natural resources. The success of the recent wars and the ability with which modern diplomatic and financial negotiations are carried out by the Japanese have afforded many remarkable objective illustrations of the thoroughness that characterises the efforts of the Japanese in the advancement of national ideals. It is proposed in this article to review briefly the Empire's mineral resources and indicate the manner in which they are being developed. But before doing so, reference will be made to the present extent of the Empire, the characteristics of the Japanese and their administrative methods.

KOREANS HEWING TIMBER FOR STAMP MILL.

The Empire of Japan comprises the four large islands of Honshiu, Hokkaido, Shikoku and Kyushiu, that have been members of the Empire for many centuries, and Korea, Formosa, a part of Saghalien, the Kiu Kiu, Kurile, Bonin and innumerable other groups of islands lying off the mainland coasts.

The population of Japan, not including the Koreans, is about 50,000,000. The people are hardy and vigorous, and are noted for their clannishness, inquisitiveness and acquisitiveness. They work harmoniously among themselves, and in many of their habits resemble the Jews more than any other people; but they do not do well in contact with other people. They do not mix well with foreign people. It is partly through recognition of this fact that the laws of the Empire are so strict in limiting the rights of foreigners residing within the Empire. It is through the development and careful guidance of the national characteristics of the Japanese, that the Government has been enabled to advance the welfare of the country to such a wonderful extent in recent years.

TRANSPORTING MINE SUPPLIES, KOREA.

Modern Japan is absolutely developed by systematic educational methods directed by the Government. These methods are not exercised in the army, navy and government departments only, but are employed in every department of national activity. The foresight and completeness with which these works are undertaken is shown by the geological and mining reconnoitering and survey operations that were carried out in Korea, Manchuria, Saghalien and northern China during the late war. While the army was operating in the field, the whole of the geological and mining staff of the Government was carrying out geological surveys that would enable the Government diplomats to value the country surveyed and decide regarding its disposition at the settlement of the war. Before the war was over, good geological and mining maps and reports were printed by the Mines Department and Imperial Geological Survey and supplied to the diplomatic officers. Most of these maps and reports have since been translated and printed in English by the Geological Survey.

The Government, at the present time, is strenuously endeavoring to develop the mining and metallurgical industries of the Empire. In order to assist and control this development it has organized an unusually well-equipped Mining Bureau along the successful lines employed by various state governments in Australia.

For the purposes of the Mining Bureau, the Empire is divided into numerous mining districts. Each mining district has its administration office and officials. These offices are under the supervision of the Central Mines Bureau, which in turn is under the supervision of the Minister of Agriculture and Commerce.

The Bureau of Mines, which is supervised by a distinguished geologist, has administration over the following subjects:

I. 1. The granting of titles to mining properties and prospecting permits.
    2. The granting of water, power, railway and other rights for mining purposes.
    3. The cancellation of such titles and permits.

II. 1. The making and filing of plans of mining operations at regular intervals.
    2. The surveying of mining works.
    3. The amalgamation and division of mining claims.

III. 1. The management of the mining police, whose duties are to supervise the exercise of the mining regulations.
    2. The regular inspection of mines and metallurgical works.
    3. The investigation of the causes of accidents.

IV. 1. The general protection of the public's interests.
    2. The printing of scientific and technical reports on mining and mining districts.
    3. The collection of statistics.
    4. The carrying out of scientific experiments relating to mining and metallurgical problems.

V. The prevention and settlement of mining disputes concerning:
    1. Mining claims and titles.
    2. Labor.
    3. Minerals.
    4. Damages to private property through mining and metallurgical operations.
    5. Financial transactions relating to mining.
    6. Infractions of the mining laws and regulations.

The Mining Laws.

The Japanese Government learned the fact at an early date that good mining laws, efficiently administered, are necessary to insure the rapid development of a country's mineral resources. Consequently, much attention has been given to the mining laws.

All mineral rights in Japan are reserved to the Imperial Government, as they are in the most advanced Australian States. Consequently, there can be no troubles through mineral deposits being locked up on private property as in America. Miners and prospectors can go on to any property anywhere in the Empire, prospect for minerals, and when successful, acquire mining titles to their finds. Land owners, when they discover minerals on their own property, must secure mining rights from the Government and commence mining operations within a given time, otherwise, strangers may apply for mining titles. This beneficent legal principle has a wonderful influence in promoting the working of mineral discoveries. If a mineral discovery has any commercial value whatever, it will be developed by the prospector or by the land owner.

All mining, water power, dam, smelting, railway, residential rights and titles are granted subject to the rules and regulations of the Mines Bureau. These rules closely follow Australian practice. Mining leases may amount to not less than four acres for gold and silver mines and forty-one acres for coal, iron and other minerals. A maximum lease for any mineral must not exceed 817 acres.

The laws and regulations are designed to keep mining in the hands of the Japanese; but in order to secure capital for large operations, provision was made in the mining regulations of 1900 for the admission of foreigners as shareholders of corporations formed in Japan and incorporated under the Imperial Japanese corporation laws. Not many foreigners have availed themselves of this privilege. It may, however, be taken advantage of later when more prospecting work has been done in Korea, a country that gives promise of becoming a large mineral producer.

Mining Methods and Machinery.

The mineral resources of the Japanese Empire are varied and all classes of mining are carried on. In many of the small placer districts operations are carried out in a primitive manner. But on all the large mining fields, the mines are operated by powerful capitalists and large companies like Fujita & Co., the Mitsubishi Company, the Hokkaido

Colliery Co., Meiji Mining Co., the Mitsui Mining Co., and the Hoden and Nippon Oil companies. The mines operated by firms like these are equipped with the latest and finest mining, power and metallurgical machinery.

The largest part of the mining machinery used in Japan, according to the latest reports of the Imperial Mines Bureau, is imported from foreign countries. The makers of the best types of machinery in every part of Europe, America and Australia are represented by machinery on one or more of the Japanese mines. Most of the machinery is purchased in England or the United States. About one-half of the machinery imported is manufactured in Great Britain, about twenty-five per cent is made in America, the balance is purchased in Europe and Australasia.

The numbers and varieties of machines employed in mining operations in Japan in 1906 and 1909 are shown in Table I.

The number of persons employed in mining operations in recent years, and mining accidents, are shown in Table II.

The total values of the mineral production and mineral imports and exports in the period 1900-1909 are shown in Table III.

New mining investments in this period, 1905-9, were larger than at any previous period. The number of new mining companies incorporated in 1909 was 233, as compared with 132 in 1908 and 195 in 1907. The new capitalization in 1909 amounts to $90,650,000 in 1909, as compared with $85,500,000 in 1907.

WESTINGHOUSE ELECTRIC MINE LOCOMOTIVE, HOKKAIDO TANKO MINE, JAPAN.

TABLE I. MINING MACHINERY STATISTICS.

		1906		1909	
		No.	H. P.	No.	H. P.
Metal Mines	Boilers	163	9,543	190	15,000
	Engines	149	7,507	150	12,000
	Electric motors	279	10,720	563	20,000
	Oil and gas engines	28	1,679	29	1,400
	Water wheels	144	11,044	192	24,000
Non-Metal Mines.	Boilers	1,110	64,597	1,400	101,000
	Engines	1,573	64,389	2,360	94,000
	Electric motors	140	4,185	300	10,500
	Oil and gas engines	62	398	154	1,200
	Water wheels	0	0	3	300

TABLE II. MINERS AND ACCIDENTS.

Year.	Persons Employed.	Deaths From Accidents. Coal Mines.	Other Mines.	Total.
1903	157,129	215	94	309
1904	164,858	189	78	267
1905	154,975	256	74	330
1906	187,922	560	203	763
1907	214,435	468	113	581
1908	205,144	236	78	314
1909	212,000	440	114	554

TABLE III. MINERAL STATISTICS.

Year.	Production.	Imports.	Exports.
1900	$25,000,000	$23,907,650	$11,180,500
1901	29,500,000	18,714,385	15,850,100
1902	29,900,000	17,938,450	15,067,550
1903	30,500,000	17,689,360	18,015,520
1904	31,000,000	28,696,770	12,777,845
1905	22,500,000	28,556,315	15,811,460
1906	57,990,000	24,745,075	21,613,330
1907	60,700,000	31,752,030	24,916,860
1908	58,190,000	27,551,045	20,512,630
1909	61,200,000	26,614,498	21,610,158

From the figures given in Table III we learn that the mineral industries of Japan are worth from $100,000,000 to $120,000,000 annually. The Empire's mineral output is much more valuable than the mineral imports and is greater than the imports and exports combined. Copper and coal mining are the most valuable of the mining industries. Copper and coal are the principal minerals exports; iron, steel, petroleum, phosphates, lead, zinc and tin are the principal imports.

COPPER MINING.

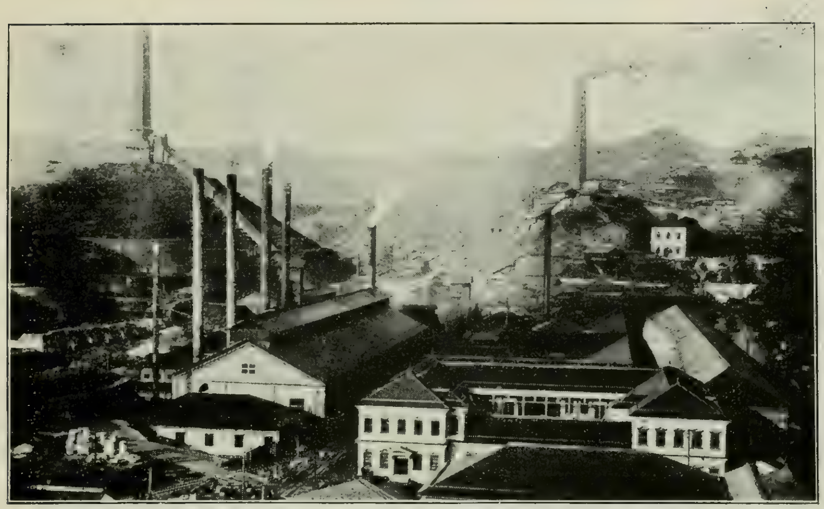
The largest mining and metallurgical works in Japan are on the copper fields. A large part of Japan, Korea and the surrounding countries is composed of gneiss, biotite schists and granite of Archæan age. These are traversed by numerous intrusive dikes and faults that have introduced hydro-thermal mineral waters into the metamorphic rocks. Iron and copper sulphides were the commonest constituents of the metasomatic agents and, consequently, iron and copper sulphides are found wherever the Archæan rocks outcrop. Copper mines are being operated in every portion of the Empire. All classes of copper formations are being mined. The largest part of the copper ore is obtained from veins. Fifty-three of the largest mines that have been regularly operated during the past six years, and produced 45 per cent of the copper in that period, were operating on the following types of copper deposits:

KOSAKA MINING VILLAGE.

TABLE IV. TYPES OF COPPER DEPOSITS.

Type.	Number of Mines.	Per Centage of Relative Production.
Veins	32	54.0
Beds	17	26.6
Metasomatic deposits	3	18.0
Contact—metamorphic deposits	7	3.0

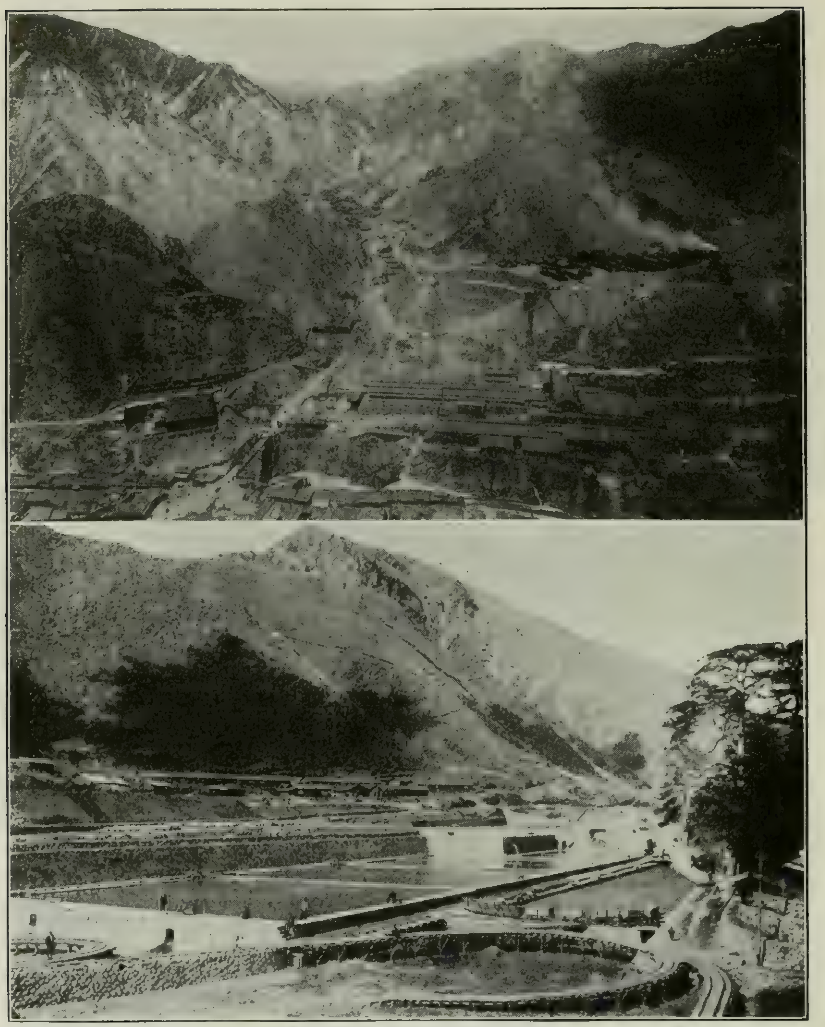
The Kosaka mine, owned by Fujita & Co., situated in the Province of Rikuchiu, is the largest and most important copper producer in



KOSAKA MINE. ADMINISTRATION BUILDING IN THE FOREGROUND.

Japan at the present time. Its annual output is between 6,000 and 7,000 tons of copper, 5,000 ounces of gold and 500,000 ounces of silver. The ore deposit is a cupriferous andesite occurring in the form of a bed about 600 feet in thickness that averages 2.2 per cent copper, 0.018 per cent silver and 0.00013 per cent gold per ton. The mining leases embrace an area of 300 acres. The deposit is mined by adit levels, cross-workings and open quarries. It is proposed in future

KOSAKA. MINING OFFICE ON LEFT.



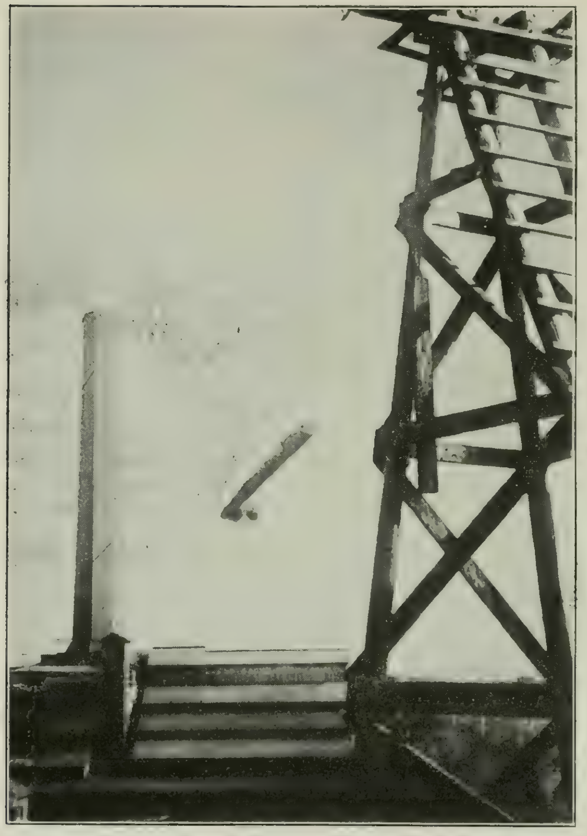
THE COPPER MINES OF ASHIO.
Above, the mining village (in the background) and the mine entrance (left foreground); below, pond for purifying waste water before discharging it into the river.

to obtain most of the ore by surface quarrying owing to the rapid oxidation of the sulphide ore causing numerous fires and vitiating the air in the mine workings. The main levels in the mine and the surface are lighted by electric lights. Water scoured electric and pneumatic machine drills are used in boring and drilling. About 5,000 persons are employed at the mine. About 800 of these are employed underground. The mining plant is up-to-date. Power is generated in water turbines and Pelton wheels and transferred by electricity. The hydro-electric power plant has a total capacity of about 2,500 horse power. The ore is reduced by cold-blast pyritic furnaces and refined electrolytically. The mine is well-equipped and managed and is very profitable.

ASHIO MINING TOWN.

The Ashio mine is next in importance. It has an annual output of between 6,000 and 7,000 long tons of metallic copper. The ore is obtained in quartz veins in clay-slates, quartzite and sandstone formations of Palæozoic age. The ore is a complex mixture of galena, pyrites, arsenical and zinc sulphides, and of chalcopyrite, gold and silver. Mining is done through vertical shafts and by levels that are well-equipped with hauling and mining machinery. Hydro-electric generators supply power for all purposes and the mine is lighted by electric lamps. About 8,000 persons are employed at the mine, 3,200 of whom are engaged in mining, 500 in smelting the ore, and the balance in transportation and other works connected with the mining and marketing of the copper. The ore is Bessemerized in the company's Nikko smelter and the copper is refined by electrolytic means. Much of the copper produced is worked up into commercial forms by the company, and the works are equipped with machinery for turning out copper wire, tubes, bars and sheets.

The Besshi mine is the largest producer among the mines operating on bed deposits. This mine was discovered in 1690 and has been



AERIAL TRAMWAY FOR CARRYING TIMBER TO ASHIO MINE

worked almost regularly since. It is estimated that up to the end of last year it has produced over 1,927,560 long tons of metallic copper. The workings are situated in a mountainous region at an altitude of 3,500 feet above sea level. The ore occurs in a chloritic schist formation that is traversed by numerous eclogyte dikes. The cupriferous bed is from 4 to 30 feet thick and over 5,000 feet in length. It dips at an angle of 45 degrees and has been mined to a depth of 2,300 feet on the incline. Pyritic smelting is practiced and power for the mine and smelting works is generated by hydroelectric machinery. The mine and smelter give employment to 2,300 men.

The Hitachi mine yields about 2,000 long tons of copper annually. This is also a bed mine. The ore occurs in a bed of amphibolite schist from 10 to 20 feet thick. It averages 5 per cent copper and carries gold and silver. The mine is well equipped with machinery. Machine drills are used in stoping. The company owning the property has its own smelters and owns the electric railway connecting the mine with the smelting works. Power is obtained from a hydroelectric plant. This is a comparatively new mine and promises to become a more important producer in the future.

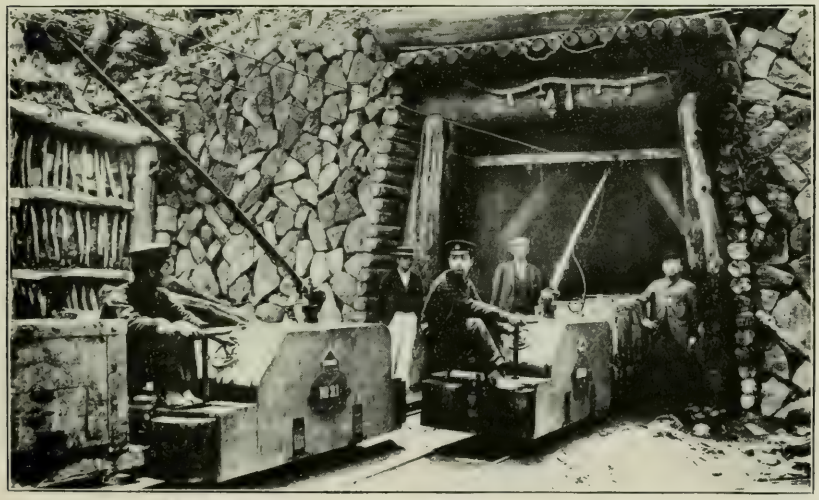
Among the other important copper mines in the Japanese Islands are the Osaruzawa, with an annual production of 2,000 long tons of copper; the Ani, 1,500 tons; Ikuno, 1,300 tons; Kano, 1,000 tons; Hibira, 900 tons; Yoshioka, 850 tons; Obiye, 800 tons; Arakawa, 750 tons; Hisanich, 700 tons; Ogoya, 700 tons; Furokura, 600 tons; and the Makimine, 550 tons. There are about thirty other mines producing between 100 and 500 tons of metallic copper yearly.

Copper occurs in many parts of Korea, but the Kap-San mine is the only important producer at present. The ore in that property is chalcopyrite mixed with arsenopyrite and pyrrhotite. It occurs in irregular masses in a limestone formation. The average value of the ore is 12 per cent copper, 45 per cent iron and 37 per cent sulphur per ton.

The copper production of Japan is summarized in Table V.

TABLE V. COPPER PRODUCTION IN JAPAN 1890-1909.

	Long Tons.		Long Tons.
1890	17,849	1900	24,939
1891	18,754	1901	26,990
1892	20,423	1902	29,144
1893	17,750	1903	32,111
1894	19,622	1904	31,653
1895	18,834	1905	34,975
1896	19,784	1906	37,950
1897	20,091	1907	39,556
1898	20,716	1908	41,113
1899	23,920	1909	43,000



ELECTRIC LOCOMOTIVE AT THE ENTRANCE TO A MINE TUNNEL, ASHIO.

GOLD MINING.

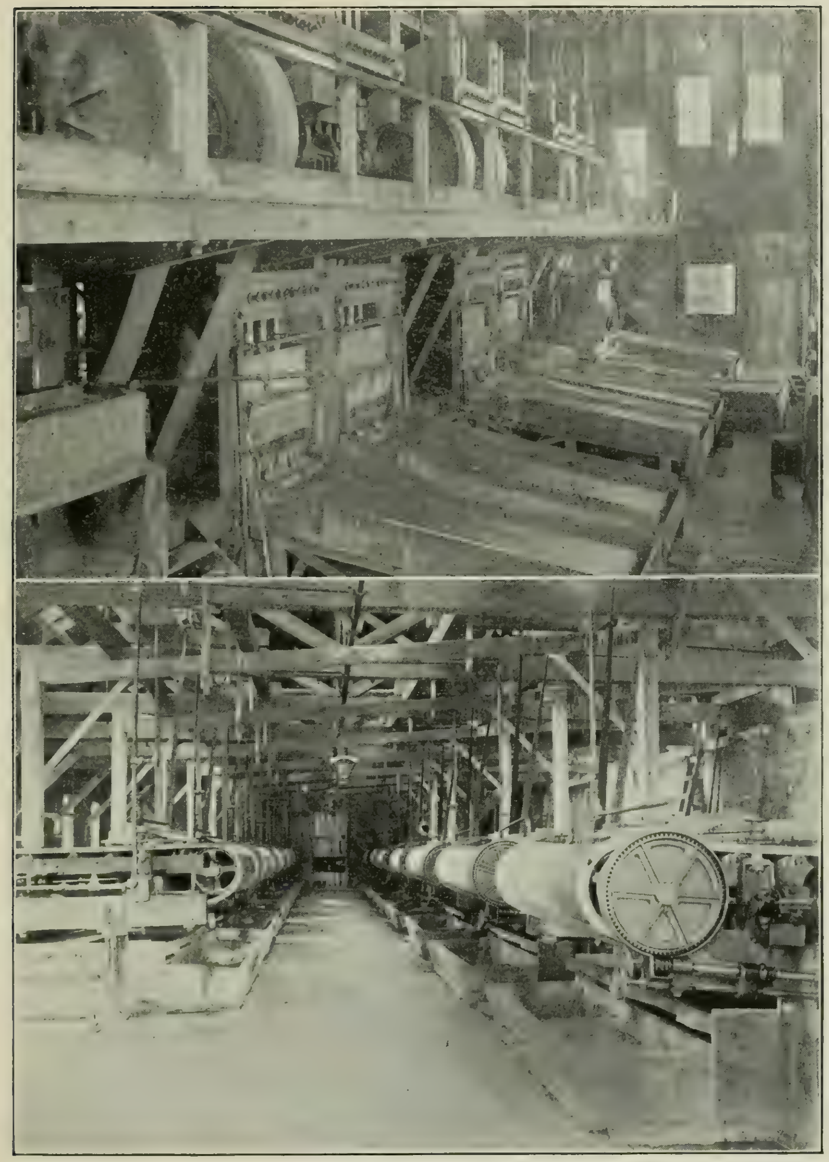
Gold has been found and worked throughout the Japanese Islands since the earliest times, but important gold workings are at present confined to a few restricted districts. The best known mines are in the northern parts of Formosa, the Province of Satsuma, and the northeastern portions of Honshu. Gold occurs in placer deposits, in combination with copper and other ores and in quartz veins. The most important vein mines are the Ponshi Karibets, Matsuoka, Handa. Takadama, Aikawa, Kuratani, Kosen, Sado, Hasami, Ushio, Okuchi, Yamagano, Botanko, Kinkwaseki, and the Dzuiho.

MAI-BONG GOLD MINE AND MILL, ORIENTAL CONSOLIDATED CO., KOREA.

The Sado mine yields between 13,000 and 14,000 ounces of gold per annum, valued at $20 per ounce. The ore is mined from quartz veins by means of four vertical shafts between 1,000 and 1,500 feet in depth. The mine is electrically lighted, and is well equipped with machinery. It has a stamp and concentrating mill, a cyanide plant and a smelter for the treatment of the lead and copper concentrates. The metallurgical treatment of the ore is as follows: It is stamped in the battery, passed over amalgamated plates and shaking tables, thence over Duncan concentrators and vanners. The lead and copper concentrates are smelted in a blast furnace with iron and marl fluxes.

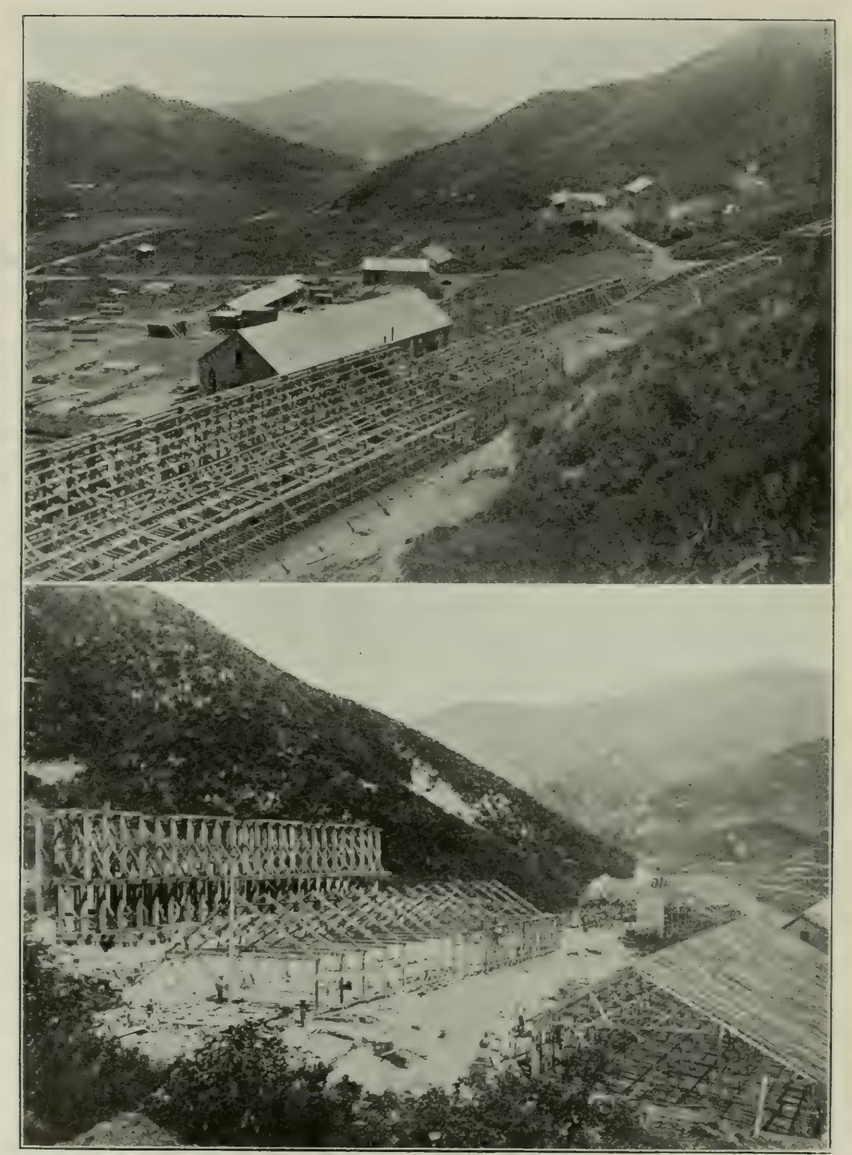
The production of the Sado mine in recent years was as follows:

Year.	Ore. Long Tons.	Gold. Ounces.	Silver. Ounces.	Copper. Long Tons.
1904..................	55,610	10,100	100,989	11
1905..................	71,612	11,595	91,501	6
1906..................	71,123	12,054	99,615	14
1907..................	71,941	13,184	116,991	6
1908..................	81,510	13,740	113,652	4



AMALGAMATING AND CONCENTRATING FLOORS, MAI-BONG MILL, KOREA.

The Ushio mine contains a 6-foot quartz vein traversing an augite andesite formation. About 20,000 tons of ore are mined annually for a yield of 10,000 ounces of gold and 6,000 ounces of silver. The bullion is obtained by amalgamation in a stamp mill and by a cyanide plant dealing with the concentrates. Hydroelectric generators are



YARACOL GOLD CAMP, KOREA. MILL AND CYANIDE PLANT.

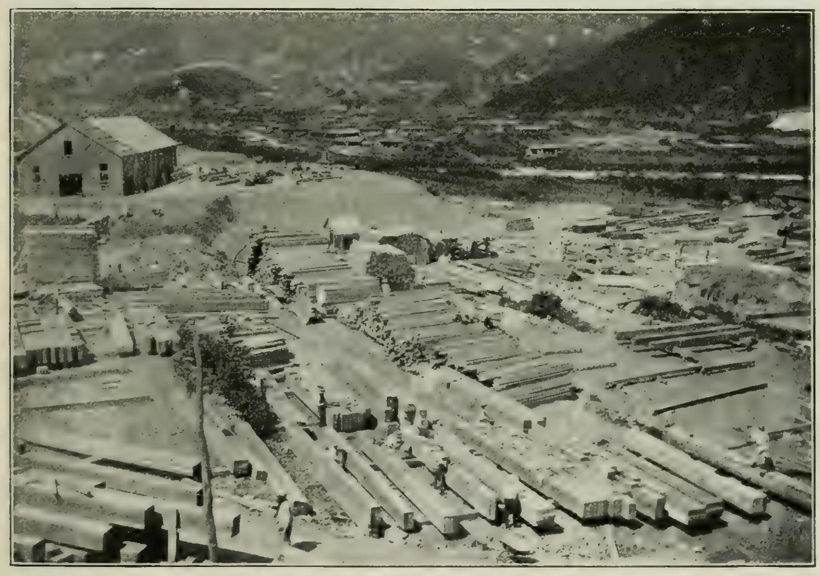
employed for supplying power. The mine is lighted by acetylene lamps.

The Kinkwaseki mine, in Formosa, contains quartz veins traversing tertiary slates and sandstones. The ore is a mixture of pyrite, chalcopyrite, zinc blende, galena and cinnabar. The veins are from

6 to 10 feet in width and have been opened to a depth of 950 feet. Hydroelectric and steam power plants are employed and stamps and cyanide plants treat the ore and tailings. The yields in recent years were as follows:

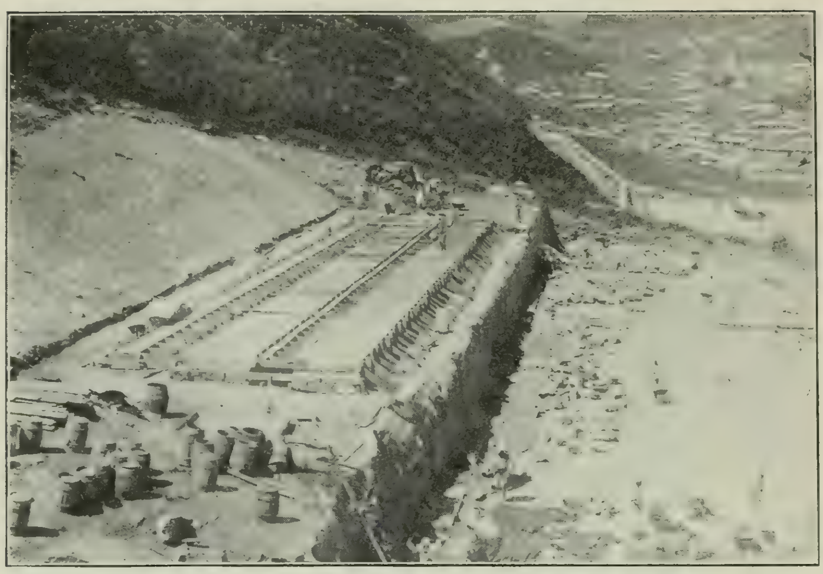
Year.	Ore. Long Tons.	Gold. Ounces.	Silver. Ounces.	Copper. Long Tons.
1904	20,000	20,571	4,024	..
1905	19,375	28,585	6,081	..
1906	25,057	16,707	4,229	..
1907	25,721	14,555	8,428	46
1908	31,054	33,353	25,558	319

The Botanko and Dzuiho mines are also in Formosa. The former yields between 15,000 and 20,000 ounces of gold and 4,000 ounces of silver per year. The Dzuiho yields 10,000 ounces gold and 5,000 ounces silver per year. Both mines are well-developed quartz-vein properties, and are well managed. The mills contain stamper batteries, Huntington mills, the latest types of concentrating machinery and cyanide plants.



YARACOL CAMP, ORIENTAL CONSOLIDATED COMPANY, KOREA. YOUCAL VILLAGE IN BACKGROUND. FRAMING YARD AND BLACKSMITH SHOP.

Gold occurs in many parts of Korea in placers, veins and disseminated in rock masses. It is mined in all these forms. The principal gold veins are mined by the Oriental Consolidated Mining Company of New York, the British-Korean Corporation and the Shibusawa and Asano Company.



FOUNDATIONS OF AN 80 STAMP MILL, YARACOL CAMP, KOREA.

The Oriental Consolidated Company operates five mines in Un-San County. The Shibusawa and Asano Company operates the Chik-San mine, and the British-Korean Corporation owns the Ap-Eun mine. All these properties are well developed and equipped with extensive modern mining, metallurgical and power plants, and are profitable. Numerous other gold mines are successfully operated by Korean, Japanese and Chinese companies. Japanese miners are doing a large amount of prospecting work in Korea at present and it is probable that their activities will result in considerably augmenting the gold yields of Korea, and of the Japanese Empire, within the next few years. The recent gold production of Japan is given in Table VI.

TABLE VI. GOLD PRODUCTION OF JAPAN.

Year.	Ounces, Troy.	Value, Dollars.	Year.	Ounces, Troy.	Value, Dollars.
1890	23,362	247,050	1900	80,596	1,625,621
1891	23,217	264,770	1901	101,683	2,334,230
1892	22,523	279,525	1902	143,993	2,826,970
1893	23,676	305,650	1903	139,623	2,770,140
1894	25,260	400,580	1904	132,814	2,728,435
1895	40,898	531,065	1905	148,645	3,064,515
1896	30,928	485,515	1906	132,986	2,799,100
1897	33,617	603,790	1907	134,153	2,773,700
1898	39,303	714,695	1908	168,883	3,493,760
1899	58,654	1,190,015	1909	170,000	3,400,000

THE NEW ERA IN ELECTRICAL ILLUMINATION.

By Rollin W. Hutchinson, Jr.

Mr. Hutchinson's review, while not neglecting the technical aspects of the newer achievements in electric lighting, will perhaps most interest readers of this magazine by its concise and practical information as to the service characteristics and relative economy in operation of the new systems and equipment. The present article is devoted to metal-filament lamps. A following section will take up the principal forms of flaming-arc and vapor lamps.—The Editors.

FOR nearly twenty years after the historical lighting of Menlo Park, New Jersey, in 1879, with Mr. Edison's carbonized-bamboo-filament incandescent lamps, the improvements in both incandescent and arc types of electric-light sources consisted more in the perfection of details than in the evolution of lamps of higher efficiencies. The low efficiencies of existing electric-light sources were the continual deprecation of the technical press. True, the appearance of "metallized" carbon lamps in the early years of the present century marked a new era in incandescent lighting, yet serviceable and economical as such lamps are, they are very inefficient as compared with the class of lamps of which they are the progenitors—the metal-filament lamps.

Following the announcement of Bremer's flaming arc lamp in 1899, came the startling advice (1903) that incandescent lamps employing filaments of the metal tantalum exhibited the remarkable efficiency of two watts per candle power and gave illumination approaching daylight in color value. Hardly had this announcement appeared before the illuminating-engineering world was again aroused from its accustomed indifference and cynicism by the almost incredible news that the rare metal tungsten (wolfram) could be employed as the resisting medium in vacuum lamps, and produce an efficiency of a small fraction over one watt per candle power, and that with a color value nearer like daylight than any other illuminant.

Since the commercialization of the metallic filament, flaming and luminous arc lamps, the electric-lighting industry, within the past three years, has been revolutionized, and central stations are still adjusting themselves to the new conditions imposed by the modern high-efficiency illuminants.

OUTDOOR ELECTRIC ILLUMINATION BY SERIES MAZDA LAMPS, CENTRAL PARK, NEW YORK.

The commanding importance of the tungsten lamp at the present moment in the electric-lighting industry is one of the most astonishing phenomena in the history of artificial illumination. After more than twenty-years usage of the ordinary carbon-filament incandescent lamp that underwent but slight improvements in efficiency during that time, and with arc lamps that degenerated from the one watt per candle-power open arc to the almost three watts per candle of the enclosed alternating-current arc, it is remarkable that artificial illumination should suddenly and almost simultaneously be produced by substitutes for both types with an increase of efficiency in both cases greatly exceeding the most extravagant hopes of the optimists in the art of illumination.

Hardly more than two years since, electric-lighting officials believed that the changes of lighting-plant business policy to adapt the industry to the new situation introduced by the metallic-filament lamps, might gradually be made on account of the slowness of manufacturers in supplying these lamps. At this writing, however, the supply of the new incandescent lamps is approaching the 125,000 per day mark, which number is being further increased by the importation of foreign lamps, while the output is being increased daily. With the present large and growing rate of production, and the fact that the new lamps have a life more than twice that of the carbon lamp with at least two-thirds less energy consumption, it should not be more than a few months before the heavy demand for the new illuminants will be met. At present most attention is centered on the higher candle-power metallic-filament lamps, principally for the reason that they offer admirable means for supplanting gas arcs and carbon electric arc lamps for street and commercial lighting, although the betterment of the art by the introduction of metallic-filament lamps for interior illumination as substitutes for the ordinary carbon-filament lamps is receiving constant attention.

The rapidity of introduction of the new lamps is somewhat augmented by the fact that the present cost of the lamps is not given great weight in formulating the policies of lighting plants. The price of metallic-filament lamps in Europe was halved almost within a year, and as periodical notices of further reductions are being made there is no reason for believing that the present scale of prices will be maintained in the United States.

It can be safely stated that the metallic-filament lamps are on a practical commercial basis and are factors in the lighting field that cannot be ignored, and that bid fair to supplant all other illuminants where electric service is available.

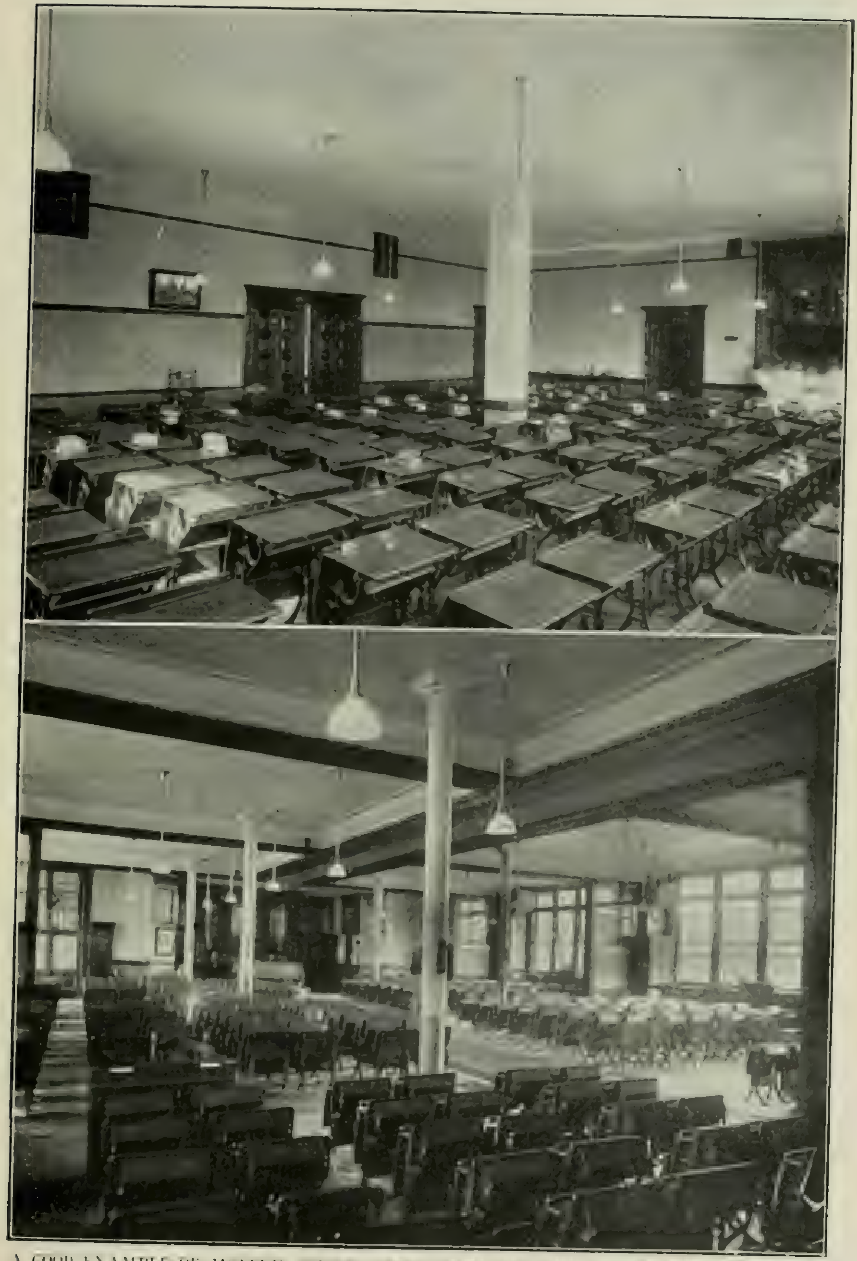
The aim of scientists and inventors since the introduction of the carbon-filament lamp has been to produce a light source which would broaden the field of electric lighting. The attainment of this end, up to the present time, has been reached with the metallic-filament lamps, particularly the tungsten-filament lamp. How early these new illuminants will by the constant process of evolution be supplanted by lamps of higher efficiency the future alone can tell. Investigators never attain the goal of their efforts, and the encouraging results obtained with still other rare minerals when employed for incandescent lamp filaments engender the belief that it only will be a few years before the present methods of incandescent-lamp lighting will be radically improved.

The desideratum in the development of artificial illuminants has been to produce a light source of maximum efficiency, or in other words, a light with the minimum of heat—a "cold light" like that with which Nature has endowed the firefly of our summer evenings. The goal, while considerably in the future, is much nearer than it was ten years ago.

This commercial application of the so-called high-efficiency lighting sources has directed the attention of the manufacturers of various illuminants such as the Nernst, Gem, Tantalum, Cooper-Hewitt, and other vapor lamps for the time being away from the problem of efficiency, and centered it upon the quality, color value, and uses of these light sources. Such a hiatus in the problem of efficient development of electric illuminants has greatly benefited the esthetic side of the art. Prior to the time when the tungsen lamp was put on a commercial basis, the electric-lighting art, if not, in fact, the whole art of artificial illumination, was in the embryonic state.

The expensive and frequently prohibitive cost of installation and operation together with only unsatisfactory light quality and poor efficiency of the high-candle-power lamps then available retarded agreements as to a true standard of illumination. The advent of the Gem and tantalum high-candle-power lamps inaugurated a marked improvement, since at one stroke the economy and illumination by electricity was improved, and the new era of single unit illumination dawned.

At this stage of development the value of reflecting and diffusing shades and reflectors was revealed. The high intrinsic illumination emitted by the new filaments coupled with their concentrated bril-



A GOOD EXAMPLE OF MODERN SCHOOL ROOM ILLUMINATION. PHOTOGRAPHED BY THE ARTIFICIAL LIGHT.

Above, 125-watt, and below 150 and 187.5-watt Gem lamps with holophane reflectors.

EFFICIENT DISPLAY WINDOW LIGHTING.
Holophane d'Olier shade with 40-watt Mazda lamps for windows; 12-inch hemisphere in entrance.

liancy, rendered essential the use of some arrangement to direct the light radiation where it would be usefully employed for the purpose desired. This necessity created the new art of reflector design in which scientific requirements had to be met. The day of the white enameled cone and the flat glass plate, which crude aids to the uniform light distribution served the carbon-filament lamp after a fashion, passed. At first glassware of curious shapes and sizes was evolved, but on account of its high absorption power proved more or less unsatisfactory. The solution was found in prismatic glassware in which the well-known principles of refraction and reflection are utilized to diffuse the light uniformly instead of merely reflecting it.

It is quite a singular fact that the initial invention of the metallic-filament lamp was made in the United States, although the commercialization of the lamps was developed by European scientists. The daring and skill of American manufacturers, however, has resulted in equalling if not excelling Continental concerns in perfection of the details of metallic-filament lamps. In the case of prismatic reflectors, however, the reverse is true. While the original prismatic reflectors were imported from Europe the ingenuity of American manufacturers has perfected the methods of manufacture. The scientific principles of illumination are being developed as an art instead of being utilized as mere details of lighting arrangements.

The metallic-filament lamps have begun to displace a number of other illuminants, both gas and electric, and for interior as well as exterior illumination. For interior lighting their high candle power and illuminating value renders possible the adoption of more delicate and harmonious color effects than ever before attained. Even in art galleries where the peculiar requirements of proper artificial lighting have been unsatisfactorily met by other light sources, the metal-filament lamp has given the proper results. The new incandescent lamps are also gradually making obsolete the open and closed types of arc lamps—gas and electric—for street lighting. As an aid to department stores, tradesmen, and shop-keepers of all kinds, the value of the metallic-filament lamps when properly installed is evidenced by the natural effect it produces in displaying wares to the best advantage.

Despite the growing field of usefulness which the tungsten lamp serves it is likely that the carbon incandescent lamp will continue to be utilized to a certain extent for lighting where economy is no great object, and in the numerous sockets where intermittent lighting only is required. This is evidenced by the fact that the output of carbon incandescent lamps in 1907 was equal to that of the boom year of 1906 but has shown a decided falling off in the last two years.

SERIES MAZDA LIGHTING, DAUPHIN ST., MOBILE, ALA.

The possible limits of incandescent electric-lamp efficiency appear to have been reached in the newer types of metallic filaments described in the pages to follow, yet who knows but that lamps using more refractory substances or giving more selective radiation of light will be produced? At the present time it would seem that the only recourse for still improving the luminous efficiency of incandescent lamps is either in the production of refractory materials with higher temperatures of volatilization for working limits, and of melting for margin of overload; or in the discovery of a filament having selective radiating properties, or in other words, one which will radiate more within the visible range of frequencies and less within the invisible range. The two features desired are not necessarily interdependent, as the property of resisting higher temperature without melting may be separate and distinct from the property of selective radiation. Perhaps no advantage will be found in selective radiation, in which event the use of highly refractory filaments will become necessary. If the solution of the problem of gaining still higher efficiencies in electrical illuminants is attempted by departing from the single incandescent lamp, the outlook is better for obtaining higher efficiencies from incandescent gases on account of the fact that all such gases radiate selectively. Hence the future for the lamp of glowing vapor appears brighter than that of the lamp of the glowing solid.

THE EFFICIENCY OF ELECTRIC ILLUMINANTS.

Efficiency of illumination is properly stated in terms of mean spherical candle-power per watt at the lamp terminals. The definition of efficiency as applied to artificial illuminants is not strictly correct as no means of determining the energy equivalent of light have as yet been devised. In practical illuminating work efficiency is understood to mean the candle-power per watt.

Efficiency of illumination may be defined as the combined effect of three different kinds of efficiencies viz: (1), Efficiency of visual perception, or the efficiency with which the eye receives light energy and translates it into visual perception. (2), Efficiency of light distribution, or the relation between total light energy generated and the light energy useful in producing desired conditions for visual perception. (3), Efficiency of the light source—i.e., the efficiency with which the chemical or electrical energy is transformed into light energy. Visual-perception efficiency is influenced by three conditions: (1) The intrinsic brilliancy of the light source and the light-reflecting objects. (2) The color of the light. (3) The steadiness and intensity of the light. Analyzing the conditions still further, it should be stated that efficiency in light distribution depends upon three important factors: (a) the distribution of light emitted by the illuminating unit; (b) the size of the unit and (c) the location of centers of light distribution.

TUNGSTEN.

Tungsten (German wolfram and sometimes so termed in English-speaking countries) is one of the rare metals, is of iron grey color and is so very hard that it can scratch glass. Its specific gravity is 19.1 (nearly equal to that of tantalum), thus being one of the heaviest of metals. It was discovered by Scheele in 1780. Until very recent years tungsten has been known to most electrical engineers only as the metal, which, when added to German silver to the extent of one or two per cent, made the alloy platinoid, which possesses a remarkably high resistivity, the value of which varies only slightly with great temperature changes.

Like osmium and tantalum, tungsten has a lower resistivity than carbon, which gives rise to the same difficulties in producing high-voltage lamps of tungsten that there is in producing high-voltage lamps of osmium and tantalum. Pure tungsten does not melt but volatilizes directly at a temperature considerably in excess of that at which the ordinary carbon filament is supposed to volatilize. This accounts for the marked increase in luminous efficiency of the tungsten lamp as compared with the carbon-filament lamp. The melting point of tungsten filaments has been determined by Waidner and Burgess to be 3,200 degrees C.

Tungsten is commercially obtainable in the form of a fine powder. The ductility of the metal is so low that it is impossible to draw it directly into a fine wire, which is quite practicable with a tantalum filament. Tungsten unites readily with oxygen and with carbon at high temperature. Hence the problem of producing tungsten filaments is extremely difficult.

THE AUER PROCESS OF MAKING TUNGSTEN FILAMENTS.

The processes and methods employed in the manufacture of tungsten lamps are both numerous and diversified, and while the majority of these are still in the experimental stage a number are in successful use and deserve detailed discussion.

In the "paste process," originally developed by Auer in the manufacture of the osmium lamp, finely divided tungsten is mixed with a suitable binder and the resulting paste is forced through diamond dies under powerful pressure. The paste is thus shaped into the proper form for a filament, which is then heated in an atmosphere of steam and hydrogen to remove the carbon in the binding material, the refined filament consisting of almost pure tungsten.

JUST-HANAMAN PROCESS.

In the process perfected by Doctors Alexender Just and Franz Hanaman, patented May 28, 1907, which is used in the manufacture of the Just lamp, a large number of which are in use in the United States, a fine filament of carbon is heated in the presence of finely divided tungsten or some tungsten compound which is readily reduced by carbon to a metal. The compound of the metal may be either tungsten oxide, tungstic acid, or tungsten sulphide. The tungsten compound is mixed with an organic binding material, such as a solution of cellulose in chloride of zinc, collodion, coal tar or the like. The filaments are then formed by pressure through a die in the usual manner, and afterwards (subsequent to denitration if collodion is employed) the filaments are carbonized. The quantity of tungsten compound used in the mixture is such that in the finished filament sufficient carbon is always present to impart the necessary strength to it, as the filament depends upon the carbon alone for strength to withstand the subsequent treatment. The specifications state that efficient filaments are obtained if from 2 to 10 grams of tungsten acid are added to a solution of 10 grams of cellulose in 260 grams of chloride of zinc whose specific gravity is 1.83. This mixture is then formed into filaments and carbonized in the absence of air and is then subjected to the following additional treatment. An electric current is passed through the filament in an atmosphere of the vapor of one of the oxyhalogen compounds of tungsten, such as tungsten oxychloride, in the presence of a little free hydrogen. Incandescing of the filament causes a reaction whereby the carbon still retained in the filament is replaced by tungsten.

KUZEL PROCESS.

This process, the invention of Dr. Kuzel a German electrochemist, consists in forming an arc between tungsten electrodes under water or possibly some other liquid, forming a so-called colloidal solution, which is then brought to the proper consistency and squirted through diamond dies. The chief advantage of this method over the two preceding ones lies in the absence of any organic matter which when present is completely removed only with the greatest difficulty, and if allowed to remain tends to reduce the life and serviceableness of the filament. The American rights to this process have recently been acquired by the General Electric Company.

General Electric Process.

A method very radically different from these two is that patented by the British Thomson-Houston Company and perfected by the General Electric Company in America. By this process the metal tungsten is rendered sufficiently ductile to be drawn into a wire, which formerly had been considered impossible. The method consists in reducing an oxide of tungsten and mixing the powder thus obtained with an amalgam of cadmium. The plastic mass which is made is pressed through a die in the usual manner and the cadmium and mercury are then driven off by heat. The filament so formed possesses the usual brittleness, but after being heated to a moderate temperature it becomes pliable and may be readily bent into any desired form. It is claimed that it is possible by this process to draw tungsten wire from rods of the metal prepared as above described by simply maintaining the metal and the dies at the proper temperature. This method is therefore one of the most promising in use at the present time as the fundamental difficulties in the making of tungsten filaments is that tungsten is not ductile and unites readily with carbon and oxygen.

The "Z" Tungsten Lamp.

This is a process in which finely divided tungsten is squirted with an organic binding material through dies, the organic material being subsequently removed. The lamp is of the multiple filament pattern, the filaments being in the shape of a hair-pin, grouped around a central glass support and connected in series. The filaments are supported by carbon hooks attached to the center stem by thin steel wires. The combination of steel wire and carbon hook forms a spring support which compensates for the expansion and contraction of the filament, and at the same time dampens the vibrations. To prevent blackening of the lamp a "special salt" is painted on the central glass stem. The initial consumption of the "Z" lamp is claimed to be 1.15 watts per candle, with an average loss of 1 per cent in candle-power for each 100 hours of burning.

Support of Tungsten Filaments.

On account of the low resistance of tungsten the filament must be either of very small cross-section or of considerable length. To make the filament of suitable length for use in incandescent lamps a compromise between these two features must be made. Even then the length of the filament is so much greater than that of the carbon incandescent lamp, and the tungsten filament is so soft when heated, that a method of supporting tungsten filaments is used radically different from the ordinary method employed in carbon lamps.

Useful Life, Radiating Power and Temperature of Tungsten-Lamp Filaments.

Of all metals which have been investigated up to the present time, only pure tungsten has a life as high as 1,000 hours when operated at about one watt per Hefner candle-power. The following figures show an interesting comparison between the electrical energy consumed and the light radiated from the surfaces of tungsten and carbon filaments. One square millimeter of tungsten filament gives 0.50 candle-power and consumes 0.55 watt; one square millimeter of carbon filament radiates 0.182 candle-power and requires 0.63 watt. Thus the tungsten filament consumes only 80 per cent of the power taken by an equal surface of the carbon filament but gives 275 per cent of the light given by the carbon filament.

In a paper read by H. Hirst before the British Institution of Electrical Engineers, the author states that "if the kind of radiation were the same in both cases, the carbon filament ought to get hotter than the tungsten filament by about 60 degrees C. because of the higher total radiation consumption per unit of surface. On the other hand, considering the greater light emanating from the tungsten filament, its temperature ought to exceed that of the carbon filament by about 200 degrees C. These contradictory conclusions show clearly how different is the radiating power of the tungsten filament as compared with the carbon filament. The latter behaves more like the "black body" of the radiation theory. Approximate calculations show that the temperature of the tungsten filament, when consuming 1.1 watts per candle-power, is about 250 degrees C. higher than that of a carbon filament taking 3.5 watts per candle-power. If a carbon filament were to be over-run to such an extent as to consume only 1.1 watts per candle-power, its temperature would have to be raised by 360 degrees C. The favorable radiating properties of the tungsten filament, therefore, mean that its temperature is 100 degrees lower than that of a carbon filament of the same specific consumption. If it were not possessed of this radiating property it would have to be operated at a consumption of 1.5 to 1.6 watts per candle-power, in order that it might have the same life it actually possesses at 1.1 watts per candle-power.

If one takes the resistance of carbon, tantalum, osmium and tungsten filaments at ordinary temperatures, the resistance at those temperatures, which in a vacuum correspond to 1.5 watts per candle, will be as follows: For a carbon filament 0.55 times the original; for tantalum 5.70 times; for osmium 8.50 times; for tungsten 11.00 times. Under normal conditions the light of a carbon-filament lamp rises and falls with the 6.3 power that of the tungsten filament with the 3.6 power of the voltage.

Effect of Voltage Variation on the Life of Tungsten Lamps.

It is not as highly essential to maintain a uniform voltage at the terminals of a tungsten lamp as upon the terminals of a carbon-filament lamp. The effect of over-voltage on a tungsten lamp is not so serious a factor in reducing the useful life of the lamp as is the case with the carbon-filament lamp; however, this should not be interpreted to mean that the supplying voltage may be allowed to fluctuate within wide limits without injurious effect. The relation between actual life and useful life (the latter being defined as the number of hours within which the candle power drops to 80 per cent of the original value), is quite different with carbon lamps and metallic-filament lamps. When metallic-filament lamps are operated at normal voltage the actual life is longer than the useful life. In other words, if a tungsten lamp is carefully handled, kept free from vibrations, and operated at normal voltage, it will decrease in candle-power to 80 per cent of the original value after 1,800 hours of burning. Under average conditions of burning, however, the filament will break before that time and if breakage occurs, for example, after 1,000 hours of burning, the candle power will have dropped by only 7 per cent of the original value. If the working voltage is higher than normal, both the useful life and the actual life decrease but the useful life falls off more quickly.

If the voltage is increased above the normal, the increase of power consumption should be proportional to the square of the voltage if the resistance of the filament remained constant. But since the resistance also increases, the energy the lamp takes increases less than the square of the voltage.

Fragility of the tungsten filament has been so far the chief drawback to the new lamp but there is evidence of material improvement in this particular. The lamps can now be shipped without much trouble and can be distributed with very small breakage. In a shipment of 75,000 one large lamp maker reports a breakage of less than 1.5 per cent, which is indeed remarkable, considering the extreme fragility of the first tungsten filaments. But when the lamps are put in the hands of the user trouble begins. It is a very singular fact that the fragile filaments will at times endure abuse and at still other times

KNITTING-MILL ILLUMINATION BY 60-WATT MAZDA LAMPS AND HOLOPHANE REFLECTORS. NOTE THE "ALMOST-LIKE-DAY-LIGHT" EFFECT.

almost an imperceptible jar will fracture them. Sometimes merely overhead vibration, a rough handling of the key socket, or a tap on the shade may break the filament. Hence one cannot exercise too much care in handling or cleaning metal-filament lamps. However, considering all the chances of breakage, the life of the new lamps is remarkably good.

The introduction of the 25-watt lamp, while of great importance in leading to better economy, is very likely to lead to more temporary difficulty from breaks. The filaments of these small lamps are exceedingly slender, and while of long life in the matter of burning, they cannot stand the shocks of thicker filaments. In an admirable editorial entitled "The Tungsten Lamp Situation," *The Electrical World* of January 2, 1909, thus speaks of the caution to be observed with the smaller candle power metal filament lamps:

> A word of warning seems to be in order about the 25-watt tungsten lamp. It is certainly a most handy size and one that is bound to be popular, but it must be dealt with rather cautiously. It is somewhat more fragile than others of its kind and while it gives excellent life if let alone it will not generally stand rough treatment. If there is need to clean the shade the lamp should first be lighted and current kept on until cleaning is done. * * *

Analysis of Cost of Operation of Tungsten and Carbon Lamps.

On account of the relative scarcity of tungsten ores, the high tariff on the importation of such ores under the new Payne-Aldrich tariff bill, and the tedious and complex processes of manufacture, the initial cost of the tungsten lamp is considerably more than that of the carbon lamp. This high first cost is however more than compensated for by the longer life and the superior efficiency of the tungsten lamp.

As an example of the economy of the tungsten lamp over the carbon lamp we will take a 40-watt (32 candle-power) tungsten lamp and a 32 candle-power carbon lamp and compute the total cost of each of these lamps when burned the same number of hours at the same price per kilowatt hour.

The high-efficiency carbon lamp has an efficiency of 3.1 watts per candle power, hence the total wattage of the 32 candle-power lamp is 99.2. Its guaranteed life is 430 hours, making its total energy consumption $430 \times 99.2 = 41{,}156$ watt hours, or 41.15 kilowatt hours during its useful life. With energy at 10 cents per kilowatt hour, its cost of operation is $41.15 \times .10 =$ \$4.11, to which should be added the first cost of the lamp, 30 cents, making its total cost \$4.41.

The 40-watt tungsten lamp has a useful life of 800 hours producing a total energy consumption during its useful life of $40 \times 800 = 32{,}000$

watt hours or 32 kilowatt hours. With energy at 10 cents per kilowatt hour its cost of operation is .10 × 32 = \$3.20, to which the cost of the lamp \$1.10 should be added, making its total cost \$4.30.

The total cost of operation of the carbon lamp for 800 hours service is \$4.41 ÷ 430 × 800 = \$12.52, while that of the tungsten lamp is \$4.30, or a saving of \$8.22 effected by the tungsten lamp.

A more significant appreciation of the economy of tungsten lamps may be obtained by a study of the reduction in the expense of lighting a small factory employing seventy-five 25-watt tungsten lamps to replace the same number of 16 candle-power carbon lamps, the lamps being in service 27 days in the month for four hours per day. The service per month would thus be 108 hours. The initial cost of the tungsten lamps at \$0.85 per lamp would be 75 × \$0.85 or \$63.75, for a life of 800 hours. Seventy-five 25-watt lamps have a total wattage of 1,875 and for 108 hours consume 1,875 × 108 ÷ 1,000 = 225 kilowatt hours. The cost for energy at 10 cents per kilowatt hour is \$0.10 × 225 = \$22.50. As the proportion of the cost of the tungsten lamps is \$8.60 for 108 hours service the total monthly cost of lighting is \$22.50 + \$8.60 = \$31.10.

The initial cost of seventy-five 16 candle-power lamps at 20 cents is \$15.00, on a guaranteed life of 400 hours. For 108 hours service their cost would be \$4.05. Their total wattage at 50 watts each would be 50 × 75 = 3,750 watts, and the monthly consumption of the lamps 450 kilowatt hours. Their cost of operation at \$0.10 per kilowatt hour would be \$0.10 × 450 = \$45.00 to which the first cost for 108 hours, \$4.05 must be added, making a total monthly cost of \$45.00 + 4.05 = \$49.05. Therefore the total monthly saving effected by substituting seventy-five 25-watt tungsten lamps for an equal number of 16 candle-power carbon lamps is \$17.95, while the illuminating efficiency of the tungsten lamp equipment is 20 per cent better. Even if the carbon lamps were *supplied free* by the lighting company there would still be a saving in using tungsten lamps at their high first cost. The question of first cost is hence not a factor in considering the tungsten lamp.

Commercial Effect of the Introduction of the Tungsten Lamp.

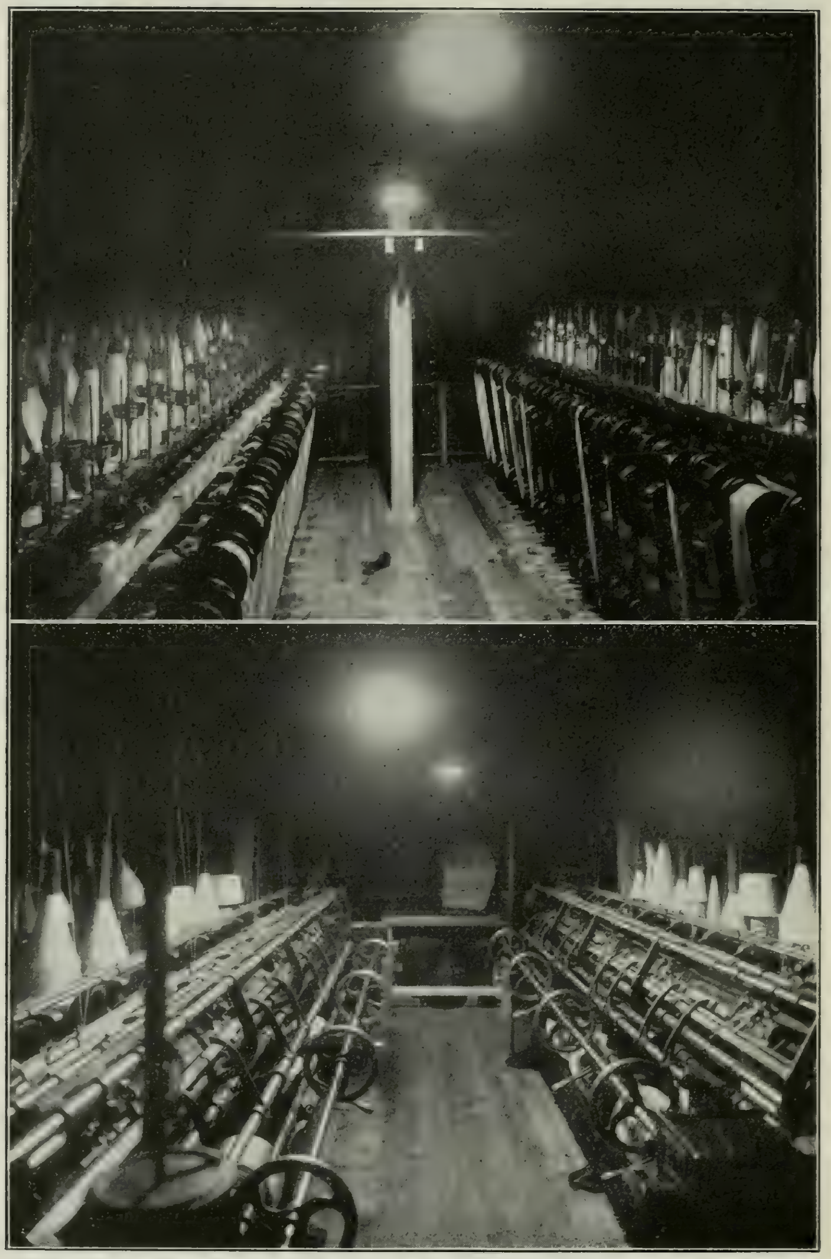
In determining the commercial effect of the introduction of the tungsten lamp, the existing as well as the possible users of electric light may be divided into three classes, depending on their probable relations to this new illuminant. The first class comprises customers who are now using electric lighting at what many be called the "maximum point," measured by the present standard of illumination, thus

MAZDA LAMP LIGHTING, CLOTH-PACKING ROOM.
Note the 40-watt lamps over the stock end of the table and 60-watt over the place where the packing is actually done.

reducing their watt-capacity and hence decreasing the revenue of the central station.

The following concrete examples may be mentioned of class one. In New York City the large retail tobacconists, the United Cigar Stores Company, has from its inception appreciated the tremendous advertising value of brilliantly lighted stores. Their recognition of electricity as the most effective means to this end caused them to expend $80,000 in the year 1907 for the electric lighting of their stores in Manhattan Borough alone. By employing the tungsten lamp they decreased this expense almost one-half, without sacrificing in the slightest their high standard of illumination.

In the second class are also present customers, but their utilization of current for lighting is below the maximum or "saturation point,"



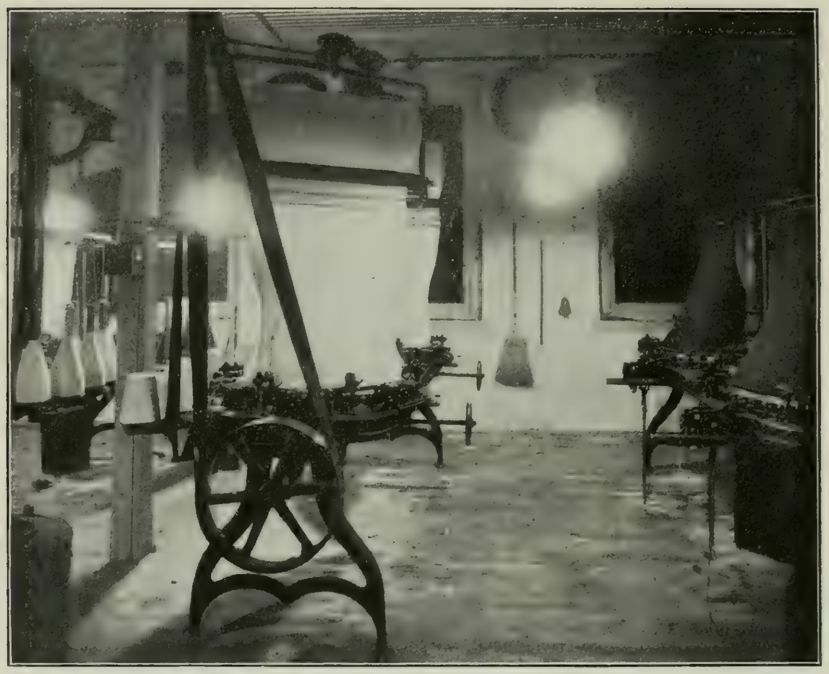
SKEIN WINDERS AND KNITTERS LIGHTED BY 60-WATT MAZDA LAMPS, ALL OTHER LIGHTS IN THE ROOM BEING TURNED OUT.

based on the present standard of illumination. Users of electric light in class two limit the amount of illumination chiefly on account of the expense involved. Central-station officials are now debating whether this class of customers will employ the tungsten lamp for the purpose of obtaining the same illumination for less money, or to obtain a greater amount of illumination for the same cost. Thus far the latter alternative seems the more popular.

INTERIOR OF KNITTING MILL, ARTIFICIALLY LIGHTED BY MAZDA LAMPS.

The more progressive of central-station officials are engaged in an active campaign among this class of customers pointing out the advantages which will be obtained from a greater amount of illumination, with a cheaper source of light. The recent appearance of multiple tungsten lamps of small candle power (20 candle-power on 25 watts) will undoubtedly prove a powerful factor in popularizing metallic-filament lamps for domestic or residence lighting.

In the third class of electric-light users are those who are at present utilizing some means of obtaining illumination other than electricity for economy's sake. It is obvious that the deficit from the loss of customers in classes one and two must be regained from class three, and at this writing the outlook augurs for not only a complete recov-



GROUP LIGHTING BY 60-WATT MAZDA LAMPS, SUGGESTING THE EFFECT ON COLOR ILLUMINATION.

ery of such loss, but also for a powerful impetus to the electric-lighting industry, due to the fact it is now able to secure a class of customers hitherto unobtainable.

Factors Which Have Retarded Rapid Introduction of Metallic-Filament Lamps.

The question which suggests itself to one after the discussion of the high efficiency and high intrinsic brillinacy of metallic-filament lamps is, why, if such lamps possess superior features to all types of incandescent lamps yet produced, has their introduction in the United States been relatively slow? The chief factor which has retarded the rapid adoption of the new lamps is the fact that American central-station customers are accustomed, in the majority of cases, to having their lamps supplied free. The relatively high cost of metallic-filament lamps requires a renewal charge which imposes a kind of inertia to their progress, and until the public appreciates the necessity of the central station in putting the new lamps on a different renewal basis from the carbon lamp, the metallic-filament lamp must struggle against this condition.

As is obvious, the new lamps must be advertised and the customers canvassed more thoroughly than is necessary where the consumer is in the habit of paying for his lamps, and hence more readily adopts and buys a new type of lamp instead of expecting the central station to supply him with lamps gratis.

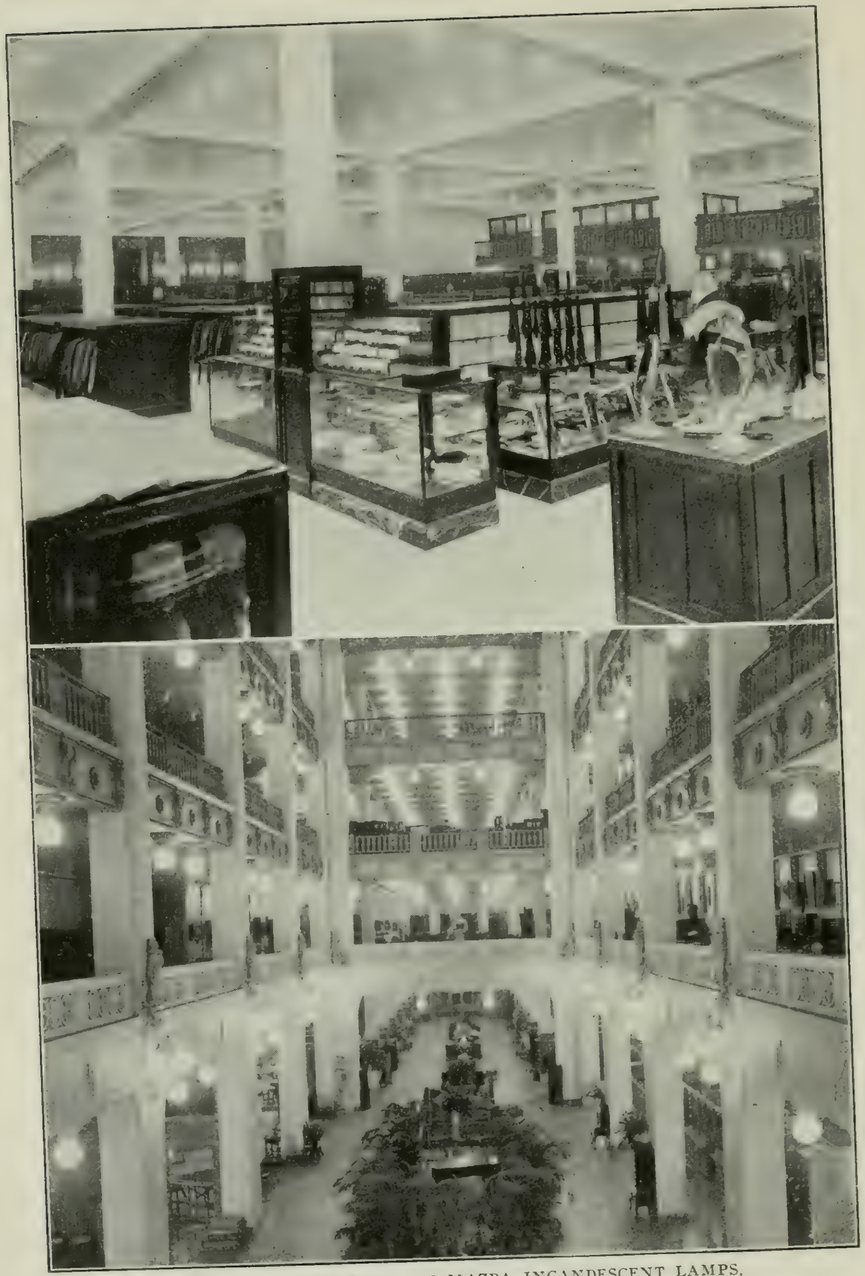
The present state of the metallic-filament lamp art and the existing commercial conditions with respect to the free renewal of incandescent lamps makes it difficult to determine the most satisfactory and desirable method of supplying tungsten lamps, but the consensus of opinion among central-station men would seem to indicate that the central-station gets the most desirable results by supplying the lamps on a monthly maintenance basis. It is left to the option of customers to buy their lamps outright and assume the risk of their breakage, or for a monthly charge the central station will undertake the supply and care of the lamps.

A fertile cause of the slowness (relative) with which the tungsten lamp has been introduced has been the necessity in most instances of changing the installation to suit the tungsten lamp, which in the units thus far supplied, give their best results when hanging in a pendant position with a single "Holophane" type reflector or enclosing globe around the lamp. Under many conditions this necessitates a re-arrangement of installations requiring, as a rule, the buying of new fixtures and changes in the location of lamps, which things the customer strenuously objects to. Therefore the employment of metallic filament lamps is under most conditions a good deal more than the substitution of one kind of lamp for another, as it necessitates such changes as new shades or fixtures, or a new layout of the lighting in a scientific manner.

Principal Field of Service of the Tantalum Lamp.

The disadvantages of tantalum lamps—chiefly the high cost of tantalum—have been mentioned, from which it can be seen that this type of metallic-filament lamp has not met with the same degree of popularity as the tungsten lamp. The majority of the tungsten lamps used in America are of the 50-watt, 25-candle-power type and of the 40-watt, 20 candle-power ratings.

The tantalum lamp has met with the best success under conditions where the central station does not give free renewals of carbon lamps, as customers of such stations, being in the habit of buying their lamps, will more readily use tantalum lamps—which is true of all the metallic-filament lamps.



INTERIOR ILLUMINATION BY MAZDA INCANDESCENT LAMPS.
Courtesy of National Electric Lamp Association.

The majority of tantalum-lamp installations have been made in isolated plants. Its most satisfactory service has been accomplished in such plants in reducing the strain of overloaded machinery, and in affording increased illumination without increase of generating equipment. Unlike some of the other metallic-filament lamps, the tantalum lamp can withstand vibration and rough service and hence is very valuable for train lighting and in any service where shocks and jars would prohibit the use of the tungsten lamp.

Proper Installation and Shading of Metallic Filament Lamps.

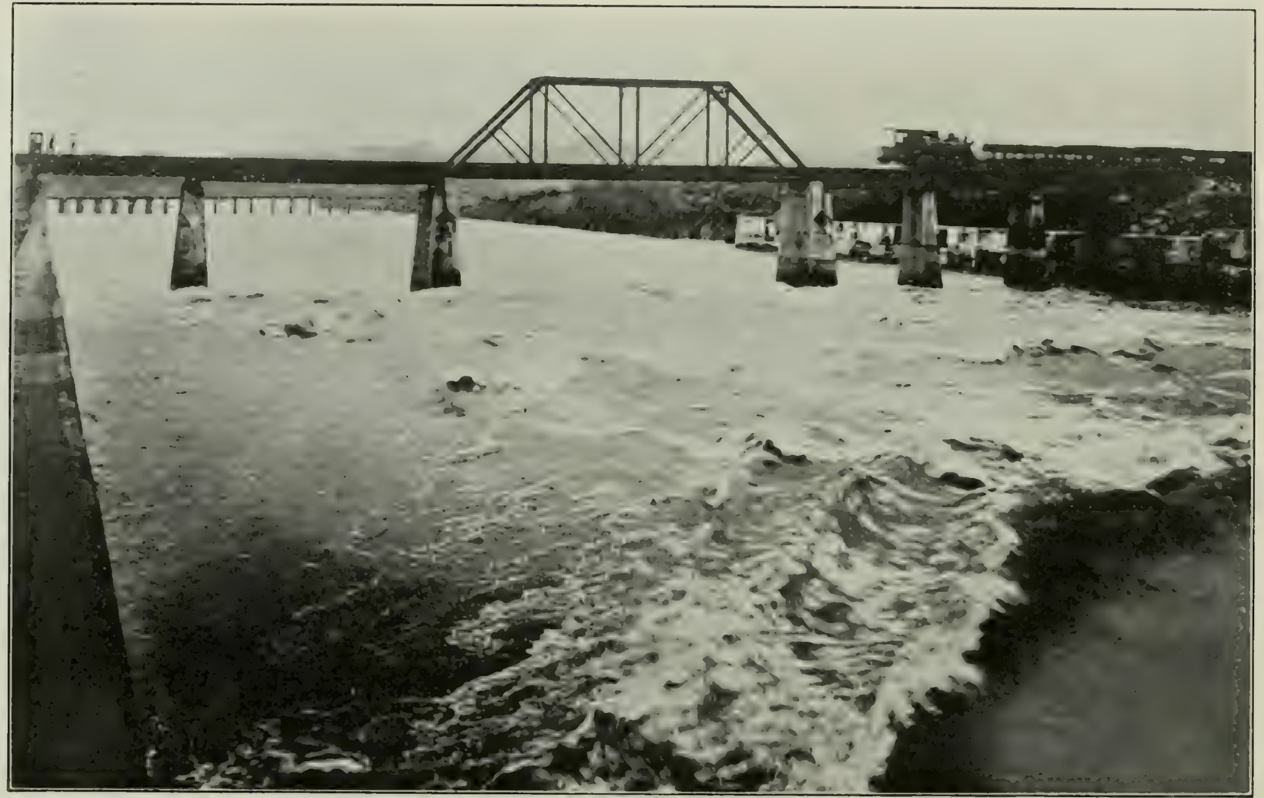
A frequent practice in installing ordinary carbon lamps with clear glass bulbs and without diffusing shades is to place them directly in the line of vision. Such practice with the new lamps of high intrinsic brilliancy is extremely dangerous as the money saved in light bills must be spent with the oculist if this precaution is disregarded.

Metallic-filament lamps should be installed well above the line of vision, or else be so shaded that their intrinsic brilliancy will be considerably reduced. Satisfactory results from such lamps can be obtained only by one or the other methods. The proper kind of shades for metallic-filament lamps is also important. The use of unsuitable fixtures for the new lamps will destroy nearly all of their improved illumination. The 40- and 100-watt tungsten lamps are frequently stuck in shades that merely form a fringe around the socket, or in shades in which they are entirely swallowed up. They are also burned in every conceivable position, which is dangerous to the life of the filament as explained.

The coming of 25-watt tungsten lamps demands additional precaution in burning and shading it properly.

The principal objections which are raised against the tungsten lamp are its fragility and high cost. These points are not without truth, although it is almost certain that improvements will in time eliminate both of these objections. The fragility of the lamp is not of serious consequence provided reasonable care is exercised in handling it.

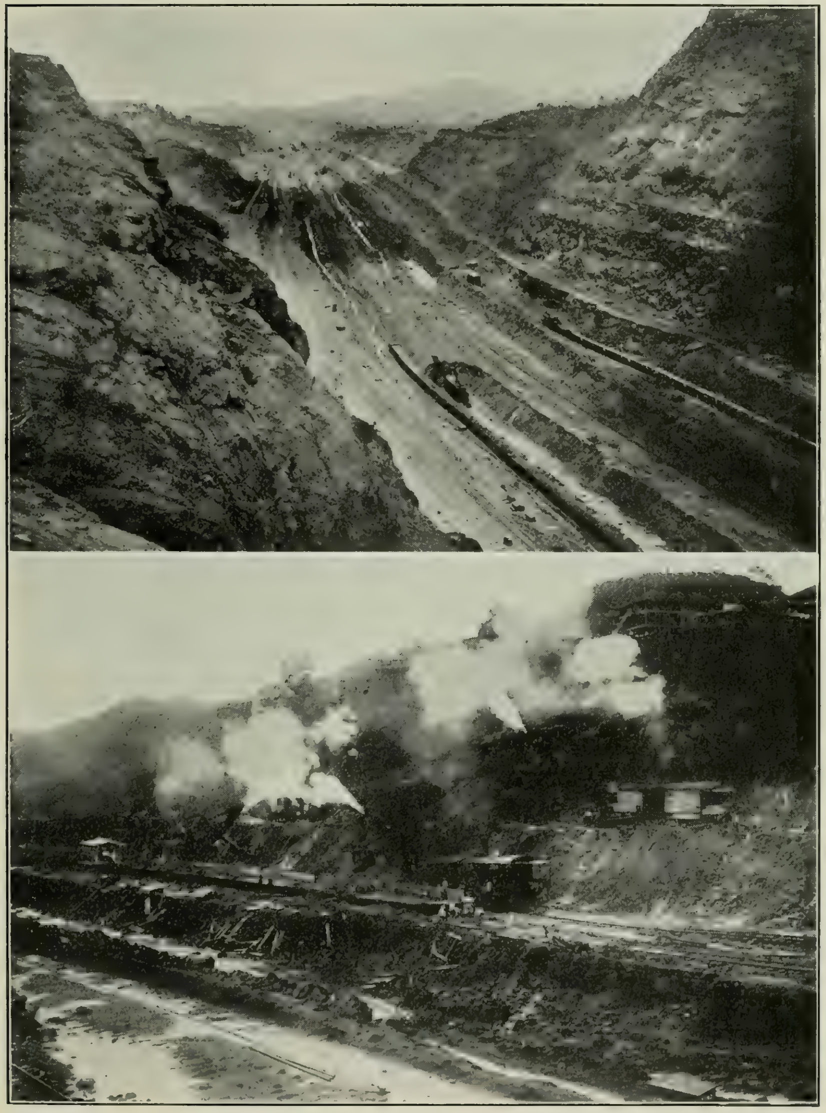
The problem of burning the lamp in other than a vertical position is somewhat more serious, although some manufacturers claim (and with truth) that their lamps may be burned in any position. The result from burning recent types of tungsten lamps, especially the 40- and 60-watt sizes, in various positions proved to the author that properly made tungsten lamps can be burned in almost any position, provided the angle with the vertical does not exceed about 45 degrees.



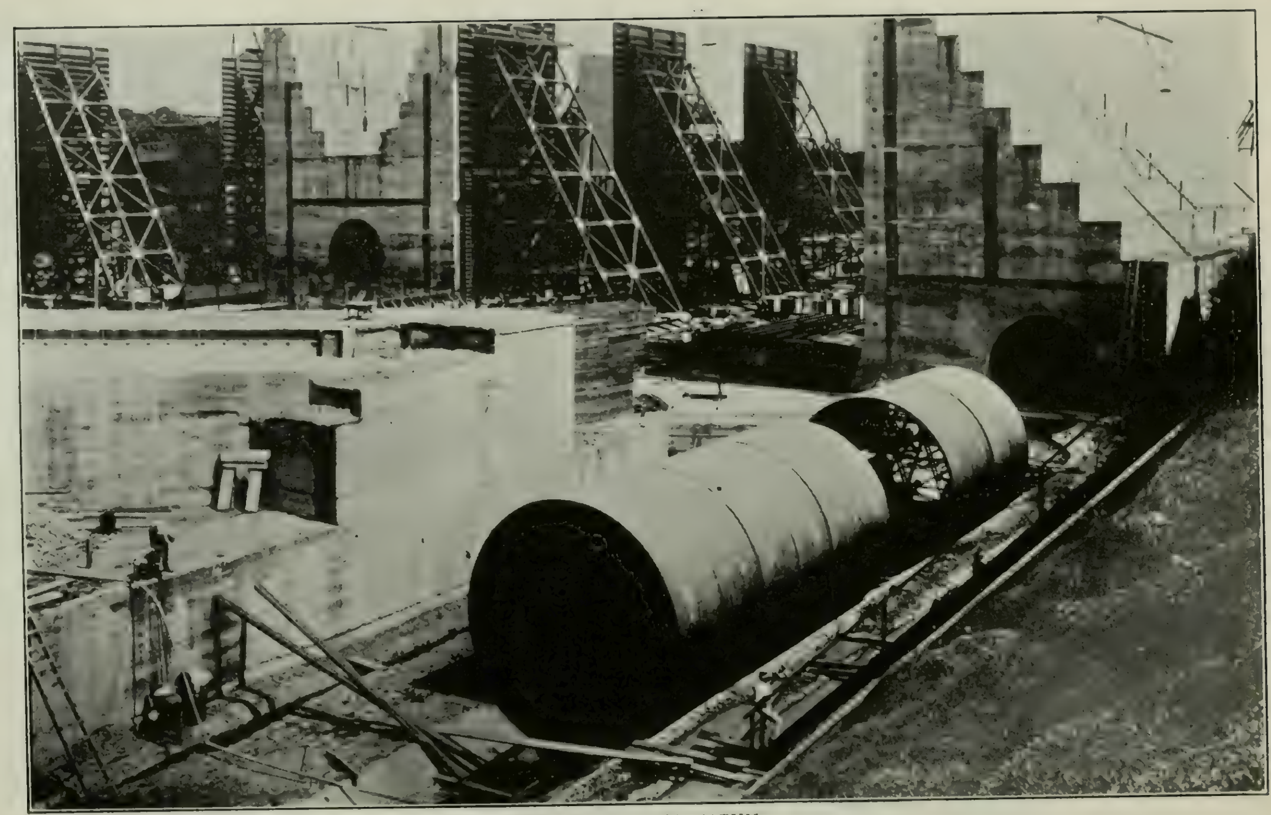
LOOKING NORTH THROUGH THE GATUN SPILLWAY.

PROGRESS IN THE CONSTRUCTION OF THE PANAMA CANAL.

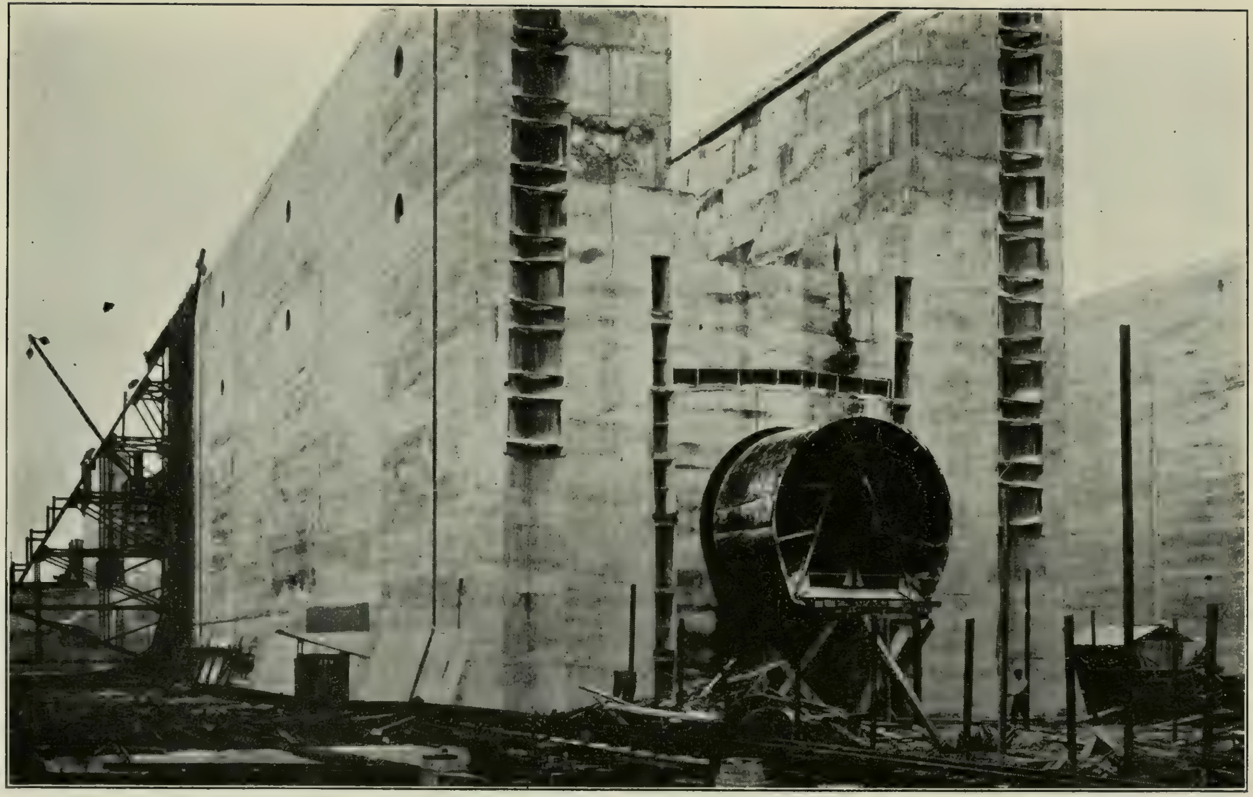
WITH ABSTRACT OF THE ANNUAL REPORT ON PAGE 427.



THE CULEBRA CUT.

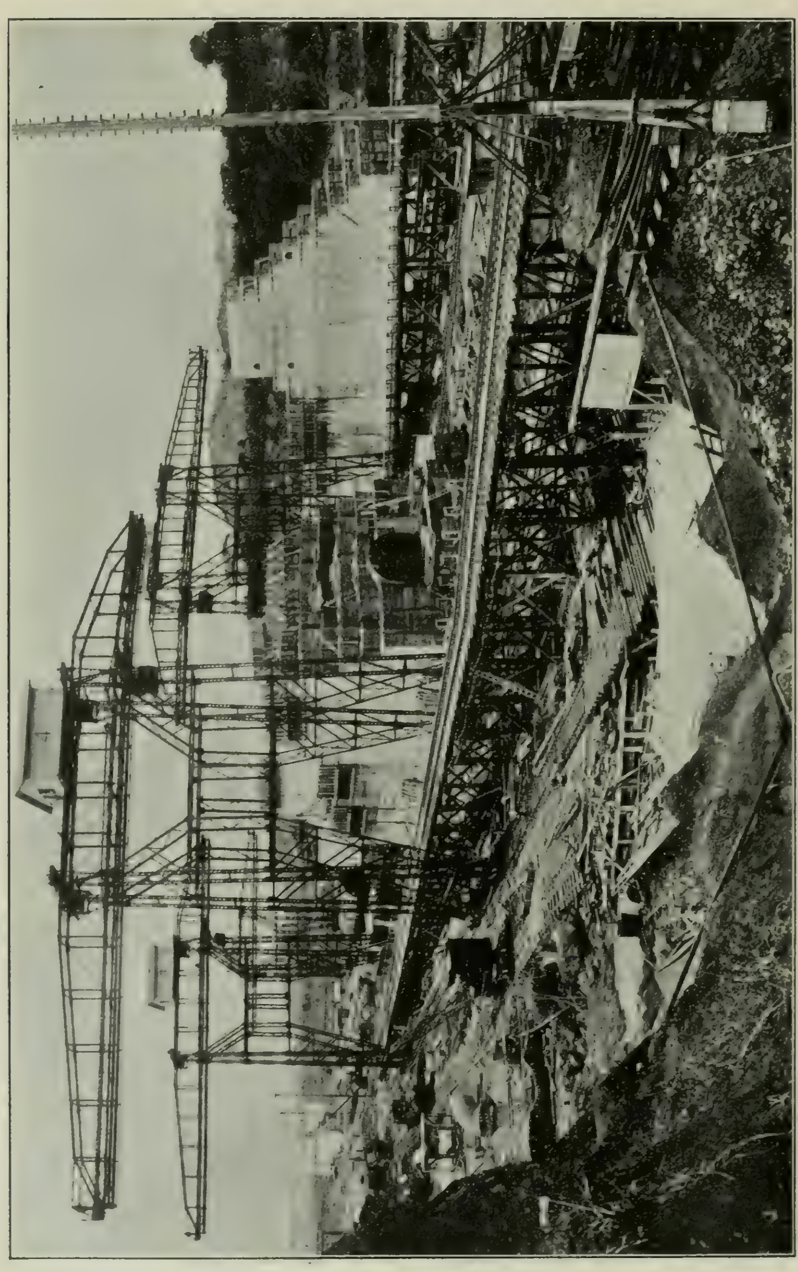


THE UPPER LOCKS, GATUN.



MONOLITHS IN THE MIDDLE WALL, GATUN.

The man in the right foreground affords an approximate scale for realizing the proportions of the work.



PEDRO MIGUEL LOCK, LOOKING SOUTH.

SYSTEMATIC FOUNDRY OPERATION AND FOUNDRY COSTS.

By C. E. Knoeppel.

III. THE PRINCIPAL ELEMENTS ENTERING INTO FOUNDRY ACCOUNTING AND MANAGEMENT.

In the article inaugurating this series, published in October last, Mr. Knoeppel outlined the elements of the foundry problem. His second paper discussed thoroughly the very important question of depreciation as its comprehension applies especially to the profitable conduct of a foundry business. He now takes up the remaining elements to be recognized in foundry organization and accounting and defines the character and limits of each.—The Editors.

IN the preceding paper, the principal elements were briefly outlined, in order to make way for a discussion of "depreciation" of sufficient length to establish the connection between it and the elements pointed out. This paper will therefore continue the discussion as regards these elements, which were found to be—

1.—Commercial production.
2.—Maintenance.
3.—Construction—
    A.—New construction.
    B.—Reconstruction.
4.—Special work chargeable to customers.
5.—Expense.

Commercial Production.—This element should comprise all castings made for sale to outside foundries, or to the company of which the foundry is a part, or to both, and should represent the *net good castings* produced in a period, with *no deductions made for whatever may be returned on account of error, defect, or other reasons.* In other words, the total castings produced in a period, less the bad castings of the same period, is the production. This may sound strange to a great many, but as I have found that the practice of several foundrymen has been to deduct from the current production whatever has been returned as defective, it seems advisable to outline what seems to be the correct procedure.

In the first place, what is produced is produced regardless of any outside consideration; and the rule should be that after castings are cleaned, carefully inspected, passed and shipped, they form a part of the production and are subject to no deductions whatever for returns from the outside. In proof of this, let us assume that in a given period, 500,000 pounds or 250 tons of castings have been produced by the foundry, costing $12,500, and that the customers in the same period have returned 50,000 pounds of defective castings, which have been billed back at a price of $50.00 per ton or $1,250. Assuming that the market value of scrap is $15 per ton, these returned castings are worth $375 to the foundry, leaving a balance of $875 which the foundry must absorb. If we *increase* the cost and *decrease* the tonnage, the cost per ton is greater (on account of the decreased divisor) than it would be if we simply increased the cost and allowed the tonnage to remain as it stood.

The following figures will clearly show just what is meant—

A—Production reduced by returns—			
Cost of 250 tons		$12,500	
Cost of returns—			
Price	$1,250		
Scrap	375		
To expense		875	
Total cost		$13,375	
Cost per ton of the 225 tons (250-25)			$59.44
B—Production not affected by returns—			
Cost of the 250 tons		$12,500	
Cost of returns (see above)		875	
Total cost		$13,375	
Cost per ton of the 250 tons			53.50
Difference in cost per ton			$5.94

It is evident that if method "A" is incorrect but in use, the results are certainly going to be misleading, for no foundryman wants to use a cost of $59.44 in estimating if $53.50 is the correct figure. Assume that in the period during which 250 tons are produced, no sales are made. The castings are piled in the storeroom ready for delivery, when along comes the 25 tons of defective castings and as a result we proceed to adjust our figures so as to read 225 tons produced at a cost of $13,375 or $59.44 per ton. Should we decide to take an inventory on the first of succeeding period, we would naturally find that we had 250 tons of castings on hand. Our book however, would show 225 tons of castings, and as their value according to the accounting is $59.44 per ton, we would naturally have to inventory 225 tons of castings at $59.44 per ton, making $13,375 and haul in 25 tons of castings from nowhere, at no value whatever—decidedly what the foundryman would not do. If, however, he inventoried 250 tons of castings at the rate $59.44, *the valuation would be $14,860 or $1,485 more than the production cost*—which would still be incorrect. If he had charged *25 tons of scrap* to the scrap account at $375 and $875 to his current producing cost and *left his production alone,* his result would be 250 tons at $53.50 per ton, making a valuation of $13,375. In case the practice in any particular foundry is to reduce current production figures by defectives returned, it should be discontinued as the above discussion should show its incorrectness.

We now come to a discussion of what should rightly be charged to the elements—Maintenance, New Construction and Reconstruction—a topic that has caused many a bitter argument, is confusing to many business enterprises, in addition to which we find that it is difficult for accountants to unite as regards a uniform or correct procedure.

Our first consideration is the fact that an expenditure of any kind either increases the value of what we may have and is therefore a charge to our assets, or it does not increase value in which case it is a charge against our revenue. Viewed in this light we can define Maintenance as—

All expenditure for work which simply *maintains,* without increasing in any way, the value of the plant, including all *repairs* and *renewals* to *real estate, buildings* and *equipment,* being the expense necessary to keep a thing in condition, operative, and useful.

The next element, New Construction, can be defined as follows—

All expenditures for work which *increases* (instead of maintaining) the value of the plant, such as *betterments, extensions* or *additions* to *real estate, buildings* and *equipment.*

The element Reconstruction can be defined as follows—

All expenditures for work which *neither increases nor maintains* the value of the plant, including any changing of what already exists which is not undertaken because it is absolutely necessary but voluntarily for some resultant advantage. To include also expenditures of an extraordinary nature, which may affect *maintenance.*

Maintenance would naturally be a charge against revenue; New Construction would be a charge to our assets while Reconstruction, neither maintaining nor increasing value, would also be a charge against revenue. It might be well to state in this connection that expenditures for Reconstruction or Maintenance classed as Reconstruction, should not be entirely absorbed by the month in which they are made. Items that are chargable to Reconstruction are generally of an extraordinary nature and it is hardly fair to make any one month absorb the entire cost. This should be spread over a period of months to be decided upon according to the facts in the case. A later paper will take up the discussion of the accounting features in connection with Maintenance, New Construction and Reconstruction.

It would appear as if the matter of correct charging would not be difficult but the task becomes complicated in the absence of a well defined way of handling the various cases as they come up, so that the problem of next importance is to outline if possible some procedure as regards a dividing line between charges to our assets and charges against revenue, in which respect misconception has done no end of harm to industrial undertakings, as a great many know—to their sorrow.

One manager whose whole aim and purpose is to *keep cost down,* will oftentimes allow this desire to get the better of his judgment and as a result items which should be charged against revenue are classified as assets. Another manager, desirous of getting at the *true showing, regardless of the effect,* will make revenue stand such items as are a legitimate charge against it. In other cases what one manager considers a charge against revenue, another will feel perfectly justified in treating as an asset. It therefore seems as if the deciding factor as regards questions affecting assets and revenue, in many instances is either personal opinion or the desire of the executive, rather than an effort to outline a uniform policy; consequently it is but natural that we should find so many different methods in practice.

Assets in the strictest acceptance of the term, should mean one of two things:

1.—Money on hand or its equivalent.

2.—That which can be converted into money.

This establishes the fact that assets are of two kinds, *quick* and *fixed.* Cash in bank and accounts receivable would come under the first class, while real estate, buildings, and equipment would be classed as fixed assets. If this is a correct interpretation of what assets are, there is no excuse for railroading into the assets accounts items which cannot pass this conversion test; for an item does not add a cent's worth of value to the plant, if the amount expended cannot be converted back into money. This test can be reduced to a more practical basis in a great many instances by the question: "Can I dispose of it for the money I have expended?" The answer to this, if the attempt to get at the truth is a conscientious one, will determine how the charge is to be made.

The question whether asset values should be considered from the standpoint of the "going concern" or the "forced sale" is entitled to some consideration. I well remember attending a forced sale of a plant which brought less than $10,000 under the hammer, although the assets were appraised at nearly $100,000. Investigation developed the fact that the plant was old and run down; no provision had ever been made for depreciation; the management had been of the "guesswork" kind and the appraisers had valued each item at the cost to replace it, consequently the assets were all out of proportion to their true value, although $10,000 was less than what the plant may have been worth.

It makes a remarkable difference in the amount that can be realized, whether a concern does not particularly care whether it sells or not or whether it is forced to sell. In the first case it can demand, and no doubt secure, a much larger figure than would be the case if the creditors took a hand. With the forced sale we find conditions that can be classed as unnatural. The buyers pay little attention to correct values—they are out for *bargains,* knowing full well that the consideration of prime importance to the creditors, first, last and all the time is—*the settlement.*

A doctor asks a certain fee for an operation, a fee on a par with that asked by other doctors. The fact that a prospective patient refuses to pay this fee is no evidence that the services are not worth what was asked for them, for he will find plenty of patients, if he is successful, who are willing to pay the regular amount. If the doctor is "up against it," he may consent to take the case for much less than the regular price; but this does not by any means represent the true value of surgical services, although as far as the doctor himself is concerned his condition forces his value down and that is as far as the influence can be made to go. My neighbor buys a piano for $600, has it a year but uses it very little. His wife dies and he decides to sell out everything. I want the piano and as we have been firm friends, he consents to sell it to me for $200. That he sold it to me for this figure is no indication that it is worth only $200, for I could no doubt get nearly as much as was originally paid for it. Friendship and a desire for a quick sale, regardless of value, were the underlying motives contributing to the decline in value to $200—a false value, as everyone can appreciate. So with the forced sale—the values are false and should not be considered as a guide in arriving at an asset value.

If an item is useful and necessary; if it facilitates production or is a business getter; if it is something that can no doubt be used to advantage by a prospective buyer, it is something of value and can be added to our assets; for it is safe to assume that it would find a buyer at the price asked. If any doubt exists, however, its cost should be absorbed by revenue—a safe and sane procedure—keeping out of the assets questionable values, which if included tend only to mislead, oftentimes with results not at all gratifying.

After all, the main thing to consider is that as long as "cost of production" is to absorb everything, it is playing safe to write all doubtful cases into cost; and if, in addition to this, the attempt to have the cost absorb items that can be rightly considered as assets is an honest one, the values will not be far off.

Definitions and a general outline as to procedure are sometimes easy to understand, but when we come to deal with specific cases we may find that the proper handling is still rather difficult on account of the various ways of looking at the subject. I know of one concern making a standard type of machine which for years has been in successful competition with other makes, where the policy is to charge all patterns and drawings on all new work to the expense account in the month in which they are made. In another concern where the designs have been constantly changing, patterns and drawings have been charged to assets, subject to a ridiculously low depreciation rate, and as a result both accounts are way in excess of what they should be. Both ways cannot be right; in fact both may be wrong, for which reason it seems advisable to get down to a discussion of cases.

CASE I.—MAKING NEW WOOD FLASKS.

A.—Stock size, for general use and not replacing old or discarded flasks—

This transaction can hardly be considered as in any way increasing value, first because of the short life of wood flasks, and second because the usual foundry wood-flask equipment is about ready to be used for firewood, and from the standpoint of a convertable security is worth next to nothing. Wood flasks are constantly wearing out, new ones being added to take their places. If they vary much as to size, is this sufficient grounds to class them as assets? Would it not be better to consider them as maintaining the value of the wood-flask equipment, which if entered as assets should be represented by a nominal figure to cover the whole equipment, subject to change only as the business expands. It would seem from the above that the case should be classed as a Maintenance item.

B.—For a special line of work—

It follows that it is the special work that makes this flask making necessary. Value has not been increased, because the flasks will no doubt be useless when the special work has been done. Nor has value been maintained according to our definition, consequently this charge should be considered as expense and absorbed by the special work to be made in them.

C.—To replace old and worn out flasks—

1.—If stock size for regular use, the expenditure would be a Maintenance item as it does not increase value to any extent, simply maintains it.

2.—If for special work, it would be a charge against the work the same as 1B.

CASE 2.—MAKING NEW IRON FLASKS.

A.—Standard sizes for general use and not replacing old or discarded flasks—

Iron flasks under the condition outlined no doubt increase value. They are necessary and useful; they facilitate production and are something a prospective buyer could use to advantage, and as they possess a much greater degree of permanency than wood flasks, we can safely class them as a New Construction item.

B.—For a special line of work—

Remarks at 1B would apply if the flasks would be of little value after the special work was made in them. Should they be so designed, however, as not only to take care of the special work but to be useful for general purposes, then it would be well to charge part of the cost against the special work and the balance to New Construction.

C.—To replace old and worn out flasks—

Remarks at 1C would apply here.

Note.—Care must be exercised in determining whether a new flask is a replacement, or for special work, or an addition to the existing equipment. The proposition is usually a confusing one for there have been cases where new flasks have been made as a replacement but put in as new equipment, because the flask was *new* and also because the fact that the ones they replaced had been lost sight of. If not rightly looked after, the proposition will soon become hopelessly confused.

CASE 3.—MAKING A LOT OF WOOD FLASKS, WITH IRON BARS, WHICH ON ACCOUNT OF THEIR CONSTRUCTION WILL LAST A REASONABLE LENGTH OF TIME.

The procedure outlined for 2 ABC seems upon consideration to take care of this case also, although the life of such flasks would be shorter than iron flasks.

CASE 4.—A NEW BELT TO REPLACE AN OLD ONE.

As this belt was added to keep the transmission equipment in good running order, it would have to be considered a Maintenance item, according to our defintion.

CASE 5.—A NEW BELT PLACED ON A NEWLY INSTALLED MACHINE.

The new machine adds value, and being a security that can be converted into money, is an asset. The belt being a component part of this machine along with the countershaft would naturally be included in the cost of the installation and also considered an asset, consequently a New Construction item.

CASE 6.—CHANGING THE LOCATION OF A DEPARTMENT.

A move of this kind neither adds value nor maintains it—as we would have just as much value after the change as before; consequently, the cost of the work would be chargeable to Reconstruction and absorbed by expense.

CASE 7.—CHANGING THE LOCATION OF DEPARTMENT AND ADDING A NEW DEPARTMENT.

As consideration will show, we have a transaction of which part neither adds nor maintains value and part adds value; hence it affects both Reconstruction and New Construction, the cost of the changing and the addition to be kept separate for correct charging.

CASE 8.—PAINTING THE BUILDINGS AND WHITEWASHING THE INTERIOR.

In this instance the work is done to maintain value, but as the expense is of an extraordinary nature it would be hardly fair to charge the cost against the month in which the work is done, for which reason it should be classed as a Reconstruction item and the cost spread over a period of months, to be decided upon as being just and equitable, Reconstruction to be credited and Maintenance charged with the monthly portions.

Case 9.—Taking Down a Line Shaft and Placing it in Another Position.

See Case 6.

Case 10.—Extending Line Shaft for an Extra Pulley and Belt.

Here we have another instance of adding something which would pass our conversion test, consequently we can class this as a New Construction item.

Case 11.—Relocating Machinery, With the View to Improving the Equipment Facilities, Making no Changes in Transmission Arrangements Excepting Where Necessary to Connect the Drives Properly.

In this case we move what is already considered as something of value, from one place to another, and add what may be necessary to effect proper transmission; but as it is more than likely that what was added replaced worn out parts, it is proper to treat this case as effecting Reconstruction.

Should it happen that quite a little new material had to be added *as an addition,* not a replacement, it being necessary to discard some of the equipment previously used, then the case should be handled by charging Reconstruction for the relocating and New Constructions for the additions, crediting the latter for the present value of this discarded material.

Case 12.—Relocating Machinery, Putting on All New Belts.

Here we have a transaction effecting both Reconstruction and Maintenance for as regards the relocation, we neither add nor maintain value, while replacing belts would be a move to maintain value. To save needless accounting however, the whole cost should be charged against Reconstruction and spread over a period of months.

Case 13.—Relocating Machinery, Installing Motor Drives to Replace Belt Drives.

In this case we can see that Reconstruction is effected for the cost of the relocating but that we have also added something of value in the way of new motors, consequently for the latter we would charge New Construction and credit it with the present value of the belts.

Case 14.—Installing a Producer-Gas Plant to Replace a Steam Equipment.

This is of course a replacement, but not made to maintain value nor in the sense that we relocate a department or machine. We eliminate something of value and add something of value. The difference in values must be considered, which gives rise to the query regarding which of the following values should be used—

1.—The difference between the present value of the steam equipment and the cost of the gas plant.

2.—The difference between what we are allowed for the steam plant and the cost of the gas plant.

3.—The difference between what we pay for the gas plant and what we sell the steam plant for.

The steam plant was put in the assets, when new, at a certain figure. It now has a value, less than the original amount by what has been absorbed by cost of production; consequently the balance remains to be returned to the business. We cannot leave this amount in our assets because we do not have this value in any convertible security; consequently we should charge New Construction for the cost of the gas plant—charging "Values Adjustment Account" and crediting Assets for the present value of the steam plant. What we are allowed in exchange or receive for selling the steam plant would be a credit to "Values Adjustment Account."

CASE 15.—EXTENDING THE CRANE RUNWAY AND REPAIRING THE REGULAR RUNWAY AT THE SAME TIME.

This transaction will be seen upon consideration to involve New Construction for the value of the extension, and Maintenance for the repairs on the regular runway. Value is increased on the one hand and maintained on the other.

CASE 16.—REPLACING THE EQUIPMENT OF METAL PINIONS WITH RAWHIDE PINIONS AND IN CERTAIN PLACES SUBSTITUTING STEEL GEARS FOR IRON GEARS.

As the cost of the work originally placing these gears and pinions in position was absorbed by assets, the work replacing them neither maintains nor increases value consequently it involves Reconstruction. The cost of the new material less the present value of the discarded pinions and gears is a just charge to New Construction.

CASE 17.—REWIRING THE PLANT; REPAIRING WHAT DOES NOT NEED REPLACING; CONCEALING THE WIRES; SUBSTITUTING TUNGSTENS FOR THE INCANDESCENTS AND FLAMING ARCS FOR THE ORDINARY ARCS IN USE, AT THE SAME TIME WIRING UP A NEW DEPARTMENT JUST CONSTRUCTED.

This case is rather a confused proposition, involivng New Construction, Reconstruction and Maintenance, as we add value, maintain value and do neither. Extreme accuracy would be possible but impracticable. The procedure would seem to be: charge Reconstruction with all of the cost of the work, less the work in the new department which would be a charge to New Construction, and increase the assets by the difference in values between the tungstens and flaming arcs and the lamps discarded.

Case 18.—Putting in a New Cupola Shell to Replace One Worn Out; Adding Two or Three Extra Courses to the Stack; Increasing the Number of Blast Connections and Relining the Cupola.

We can outline the procedure for this case as follows—

Putting in new shell.	To Maintenance on account of value being maintained.
Relining cupolas.	
Adding extra courses.	To New Construction on account of value being added.
Increasing connections.	

the cost of the work less the value of the new items to be charged to Reconstruction on account of the work being of an extraordinary nature, and spread over a period of months.

Case 19.—Throwing Out a Moulding Machine Which Has Not Measured up to the Expectations and Installing a Better Type.

While adding something of value, we are also losing something of value. To handle this transaction properly so as to produce a true showing, the procedure should be along the same lines outlined in Case 14.

Case 20.—Making New Patterns and Drawings.

A.—For an improved type of a standard machine.
B.—To suit the wish of a customer.
C.—To correct a fault existing in the design of a machine.
D.—For a new and untried type of machine.
E.—For maintenance of equipment.
F.—For new equipment.

The correct handling of the cost of patterns and drawings has always been a source of considerable discussion. A statement showing "net worth" which included all patterns and drawings would be open to question; in fact, an executive in favor of charging his own patterns and drawings to assets would be the last men to sanction the purchase of another concern without first satisfying himself that he was not going to pay for patterns and drawings that were of little value to his business, which gives rise to the query: what patterns and drawings are of value to a business?

In one sense it is doubtful if any are. New manufacturing processes, new tools, better designs, the failure of designs to be a commercial success, and numerous other reasons, all contribute to make patterns and drawing a doubtful quantity as regards their value. Uncertainty is another factor. What might be considered an asset may prove a failure, and on the other hand what was considered problematical and not regarded as an asset may prove to be a great success. It seems therefore as if no definite method of procedure can be outlined. If, however, the viewpoint is not so much the desire to get as much as possible into the assets as it is to make production absorb capital charges, it makes it unnecessary to "split hairs" in deciding just how to proceed. If the cost is absorbed at once, revenue takes care of what would otherwise be a capital investment—the safest way. If the cost is considered an asset and spread over a period of years, capital investment is returned slowly (in one case I know of, 3 per cent annually on decreasing balances is considered a correct pattern and drawing depreciation) sometimes much more slowly than the corresponding discarding of patterns and drawings—a procedure that assesses each year, after a certain period, with an unjust cost.

Getting back to the case outlined, a procedure might be outlined as follows:

20A.—As the type of machine is standard and the improvement made only after it has been demonstrated that it will make the design more efficient, it is safe to consider this an asset. The estimated life of the design, however, should not be placed at a figure which is equivalent to saying that it will never be declared obsolete. It must be remembered, as pointed out in the preceding paper, that the whole aim and purpose of a depreciation allowance is to have production refund capital investment, and the more quickly it is returned, the better.

20B.—This is obviously a charge against the contract, as it is the customer's wish which makes the change necessary. He may or not be willing to pay for this change, but this does not alter the fact that value is not increased nor is it maintained.

20C.—If a fault exists in the design, it means that the security is not as valuable as it should be; consequently to make it valuable to the trade (which is only another way of saying that it is of value to us) we must expend enough to make it so—hence the item is a charge against revenue.

20D.—Here we have an element of chance. It is possible that the type will be a success—it is just as likely however, to be a failure. We do not know as yet whether we have anything of value of not; consequently it is not playing safe to call it convertible security, if it is not known that such is or will be the case. The safest plan is therefore to make the current year stand the expense, one-twelfth per month, if the expense exceeds a figure decided upon, or the current month if the cost is a small one.

20E. and F.—The cost of patterns and drawings for new equipment would naturally be a New Construction item, while if for Maintenance, revenue would have to absorb it.

THE ECONOMY OF SMOKE PREVENTION.

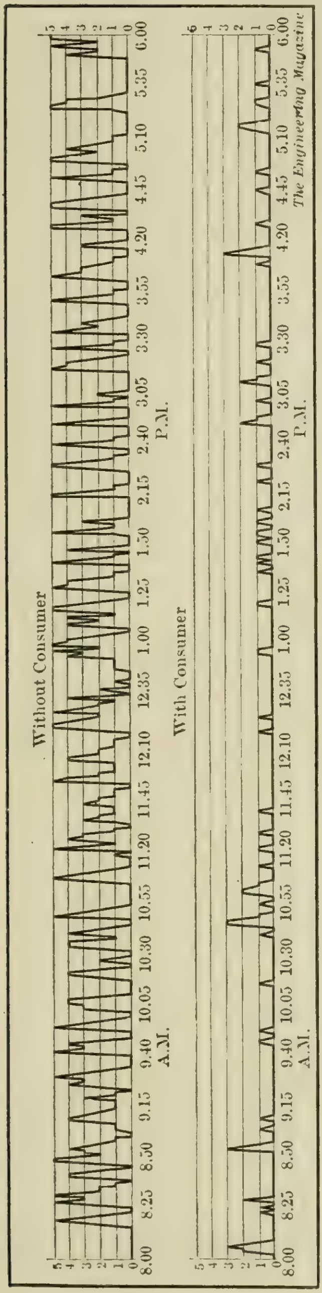
By J. A. Switzer.

Professor Switzer's paper is of special interest because it offers exact, quantitative testimony from an unbiased source on an often disputed point—the possible effectiveness and the operating cost of proper steam-jet devices for the boiler furnace.—The Editors.

THE dream of a smokeless city, however desirable its realization may be, would, I fear, remain but a Utopian dream were it not for the saving fact that smoke prevention is waste prevention. Show a manufacturer that by ceasing to contribute his quota to the city's smoke he can make an appreciable saving on his own coal bill, and he will give you a respectful hearing. Smoke prevention in the future is to be attained, doubtless, by the installation of boiler plants properly designed to carry on smokeless combustion, and strict prohibition of the erection of any other kind; but those of us who are alive today are interested in the immediate abatement, or at least the immediate amelioration, of the smoke nuisance.

Among the present-day types of boiler and boiler setting the worst offender is the ordinary return-tubular boiler set directly over and quite close to the grates, and fired with bituminous coal. It is, too, the most prevalent. What hope is there for this type of plant?

Hope there certainly is. There are now on the market some half-dozen designs of so-called "smoke consumers," (more properly designated as smoke preventers) all operating on essentially the same principle; that of injecting an adequate supply of heated air into the combustion chamber whenever by reason of adding fresh fuel the increased air supply in needed. This is accomplished by the use of steam jets, automatically controlled. The makers of these devices are, of course, not slow to lay claim to large economies resulting from the use of their apparatus. And their claims are seemingly upheld by the publication of boiler trials made "before and after taking." An evaporation of so-and-so many pounds of water is increased by the "consumer" to so-and-so many pounds. But none of these reports, so far as I know, includes any statement of what part of the increased evaporation is utilized in merely operating the jets themselves. One is left to infer the amount is quite negligible.



The Engineering Magazine

SMOKE CHARTS OF THE TRIAL RUNS WITH AND WITHOUT STEAM-JETS.

With the particular aim of determining this point, a test of one of these devices was recently made under my direction by students at the University of Tennessee. The device consists of four steam jets passing through the boiler front and discharging into the combustion chamber directly over the fire-doors; a valve in the steam line supplying the jets is so connected to the fire-doors as to be opened whenever either fire-door is opened, and connected also to a dash-pot arrangement by means of which the valve closes slowly and only after a predetermined period following the closing of the fire-door; there is also a damper upon each fire-door, which also is connected to the dash-pot arrangement in such a manner that when the fire-door is closed the dampers remain open for a few minutes (thus providing an avenue for the inspiration of air) and then slowly close coincidentally as the steam supply to the jets is slowly diminished.

The test of this device consisted of two 10-hour trials of the boiler conducted on successive days with conditions as nearly alike as possible, save that on the second day the smoke preventer was in operation, but not on the first day. The trials were carried through in accordance with the code, and attention was given to every least detail of a regular boiler trial. Smoke observations were made and charts plotted on the Ringelmann scale. A close study of

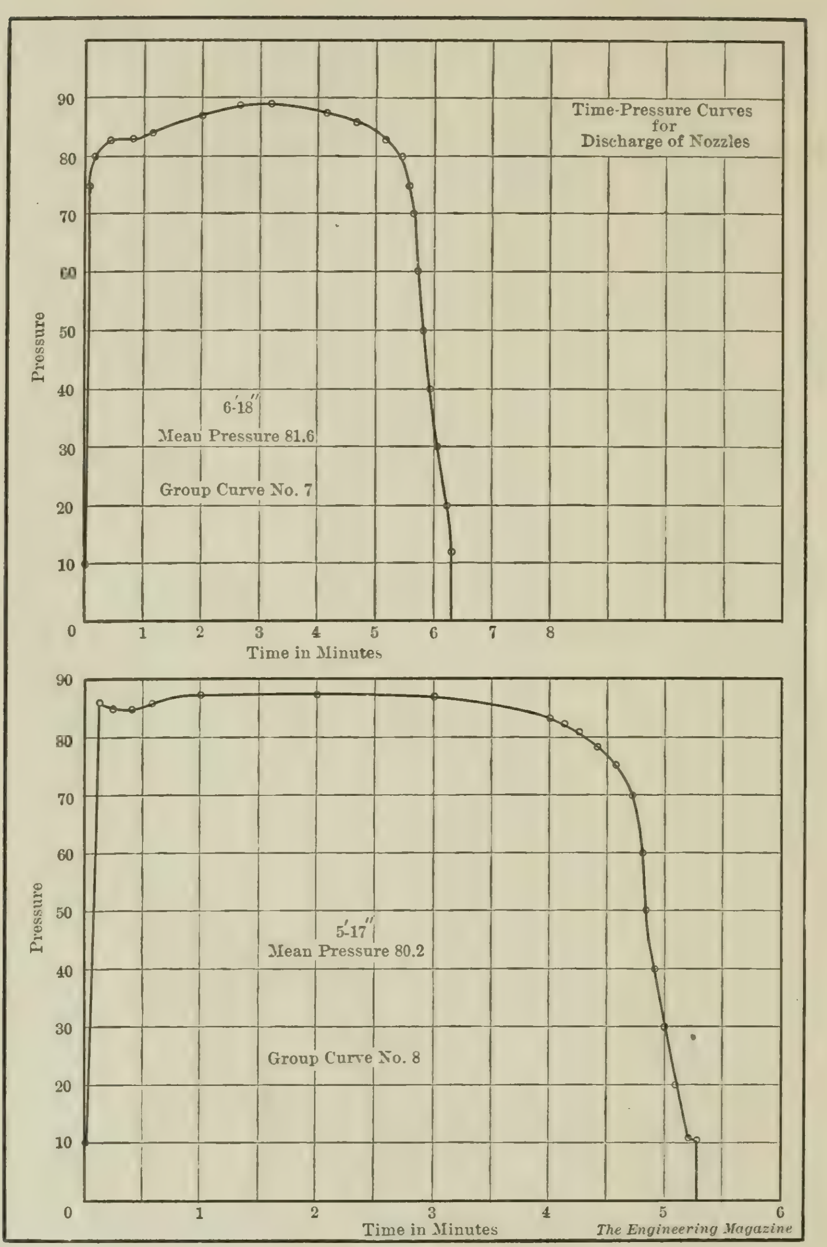


FIG. I. CLOSING CURVES OF STEAM-JET APPARATUS.

the smoke charts is not required to demonstrate that the preventer really does prevent the formation of objectionable smoke. It should be remarked that on the occasion of both trials the stoking was done with intelligence, and equally so for both trials.

In order to determine precisely the quantity of steam passing through the jets of the preventer during the second boiler trial, rather an elaborate set of observations was necessitated. A standard test steam gauge had been placed on the pipe supplying steam to the jets. In front of this an observer was stationed, stop-watch in hand. Each time that one of the fire-doors was opened either for stoking or for any other purpose, the watch was started and as rapidly as he could the observer recorded the steam pressure on the jets and the elapsed time. A period varying from 10 to 30 seconds was found to be required for the pressure to attain its maximum. It remained at its maximum for a longer or shorter period, depending upon the promptness with which the fire-door was closed. Following the closing of the fire-door, the slow operation of the dash-pot throttled the steam down slowly to its minimum pressure. The time required for this part of the operation was not uniform, owing possibly to some lack of nice adjustment of the dash-pot arrangement. The observations with the stop-watch were not concluded until the steam pressure had reached its minimum value, at which it was intentionally maintained between times. For each of these sets of operations (of which there were 41 during the 10 hours) a curve was plotted between time as abscissa and pressure as ordinate. Figure 1 shows two typical plottings. We call these the "closing curves," and in order to interpret them into pounds of steam consumed, a calibration test of the jets was made. To accomplish this the steam pipe carrying the nozzles was turned from its operative position across the front of the boiler setting to one in which the nozzles could discharge into a surface condenser of special design. With this arrangement perfected, the calibration test was run. Twelve sets of observations constituted the run; for each set the steam pressure was maintained constant and the discharge rate measured. The observations ranged from the full boiler pressure as a maximum to the minimum pressure utilized during operation of the device. Figure 2 is the calibration curve, plotted between pressure as abscissa and discharge in pounds of steam per second as ordinate.

Now by means of a planimeter the mean ordinate of each closing curve was determined, and from the calibration curve the corresponding discharge rate was read off. This discharge rate being assumed to

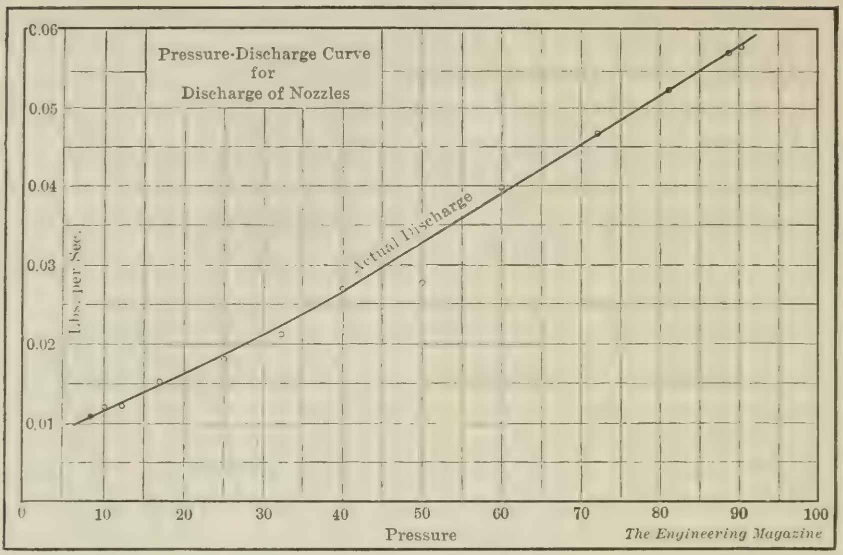


FIG. 2. CALIBRATION CURVE.

be the average rate for the particular closing curve, the total discharge is obtained by multiplying the rate by the duration of the operation. To carry this process of calculation through for the 41 operations was deemed unnecessarily laborious, inasmuch as the operations easily fell into groups of closely similar performances. Accordingly it was found that nine such groups could be formed and thus simplify the calculations without sacrifice of accuracy.

The calculations of discharge are tabulated below:

TABLE OF CALCULATIONS OF DISCHARGE.

Pressure Curve No.	Mean Pressure From Mean Ordinate.	Steam Discharge Per Sec. From Curve.	No. of Operations Per Group.	No. of Seconds Per Group.	Total Steam Per Group.
1	84.8	.0545	7	3,872	211.0
2	69.4	.0447	3	1,569	74.8
3	84.2	.0541	1	1,180	63.8
4	79.8	.0514	4	2,243	115.3
5	81.0	.0521	10	5,060	264.0
6	79.2	.0509	3	1,377	70.1
7	81.6	.0525	4	1,580	83.0
8	80.2	.0516	6	1,884	97.2
9	78.6	.0503	3	680	34.4
Totals			41	19,579	1,014.5

This table takes into account only the time during which the consumer was open.

No. of seconds closed...................... = 16,421
At 7 pounds pressure, discharging per second. = 0.0115 pounds
Total discharge .... = 188.8 pounds
Grand total for 10 hours..................... = 1,203.3 pounds
Per cent of total steam used by consumer..... = 4.6 per cent

With this figure determined, a comparison of the two boiler performances becomes very interesting; and in order to facilitate the comparison, the principal data are shown in parallel columns:

Size of boiler, builder's rating, 75 horse-power.
Kind of coal, bituminous.

		1st Trial.	2nd Trial.
Heat value of coal..................	B. t. u. per lb.	13,592	13,374
Total coal consumed................	Pounds	2,850	3,200
Total combustible	"	2,270	2,757
Per cent. CO^2 in flue gas............	Per cent.	11.2	11.0
Draft gauge near damper...........	Inches, water.	.093	.119
Steam pressure	Pounds	96	96
Temperature, flue gas...............	F. degrees...	313	217
" feed water............	"	137	133
Total feed water....................	Pounds	19,007	25,821
Actual evaporation per pound dry coal.	"	6.7	8.0
" useful evaporation per pound dry coal	"	6.7	7.7
Equivalent evaporation per pound dry coal from and at 212 degrees...	"	7.4	9.0
Equivalent useful evaporation per pound dry coal from and at 212 degrees	"	7.4	8.6
Equivalent evaporation per pound combustible, from and at 212 degrees	"	9.0	10.4
Equivalent useful evaporation per pound combustible, from and at 212 degrees	"	9.0	9.8
Horsepower (useful) on basis 34½ pounds equivalent evaporation	"	59.5	79.0
Efficiency of the plant.............	Per cent.....	52.6	62.1

Owing to the fact that the load upon the boiler was not the same for both trials, the increase in economy cannot be wholly attributed to the use of the automatic jets, although doubtless the major part of the increase should be credited to this source. The difference in loading serves, however, to emphasize the effectiveness of the device in preventing smoke; for while without its use the boiler cannot be driven up to 80 per cent of its rated capacity without producing dense black smoke, the use of the jets permitted the boiler to carry 105 per cent of its rated capacity with entire absence of objectionable smoke.

Hence the demonstration is made not only that smoke prevention even with the worst type of high-pressure steam boiler is possible, but also that its prevention is a measure of no little economy.

Armed with proofs of such potency as this, the advocates of smoke prevention should push their campaign for an unpolluted atmosphere with unflagging presistence. The arguments are all on their side: arrayed against them are no considerations of even selfish interest—nothing, indeed, except a stolid ignorance, blind alike to self-interest and to the rights of the community.

THE TWELVE PRINCIPLES OF EFFICIENCY.

By Harrington Emerson.

VII. THE FIFTH PRINCIPLE: THE FAIR DEAL.

"We have progressed so rapidly in material prosperity that we have lost our heart and our humanity."—W. L. Ward.

"Either side gets just what it grabs. Hence if I were a workman I would go back into the union and fight fiercely for a high, straight wage and eight hours and if I were an employer I would battle for straight piece work. To my mind the matter of justice is chimerical bosh. Either side will get just what it has power to take. It is the law, the fight of life. The mechanical industrial army is now to America what the Prætorian Guard was to the Roman Empire—at once the support and menace to the country.

"For this reason I helplessly turn to the sole recourse of laughing at the individuals who become flushed in their earnestness over the details of the struggle. Nevertheless I think great work was done on the Santa Fe—no one better than myself knows the obstacles to overcome in order to make your plan work. It seems to have smoothed down in a masterful manner the plumage ruffled by the antecedent strike. While I do not personally believe in the protestation of a desire for fair play, you seem to have convinced notable representatives of both sides of the plausibility of an impossibility."—Extract from letter written July, 1907, by the associate editor of "the oldest journal and the leading journal of its kind, published at the greatest railway center in the world."

We have ventured to place the extract above in immediate juxtaposition to Ward's dictum, because it is a specific definition of the mental attitude of the employing class which is the most serious obstacle in the way to a better, a more efficient, order. It formulates the doctrines to which the Twelve Principles of Efficiency are an earnest gospel of dissent.—The Editors.

THIRTY years ago there was a deep-worn trail leading from the plains of Texas to the forks of the Platte, a distance of 800 miles. This trail I could recognize by its furrowed hollows if I drove across it in darkest night. Long-horned, wild-eyed, cat-hammed Texas steers, half a million in a season's drive, slowly grazed northwards, bringing Texas fever with them. The heifers were retained in Texas to become the dams of other inferior long-horns. All this is changed. Short-horn, Hereford, Galloway bulls have resulted in graded short-horn, well rounded, well mannered progeny which travels north in palace stock cars and there is strict quarantine against Texas fever.

The best basis for peace, for harmony, for high performance, is selection of the human thoroughbreds, exclusion of the undesirable human Texas long-horns.

It is in this manner that our future officers, military and naval, are recruited. Having been carefully selected they are given the fair deal. During good behavior they remain; their promotion is sure although slow, their position is high, they are welcome guests in society and at the most exclusive clubs.

Should the practices based on several thousand years of experience not be taken to heart by industrial organizers?

The captain of a whaler recruits his motley crew by fraud and violence and rules them with the discipline of the Old Testament: eye for eye, tooth for tooth, hand for hand, foot for foot, burning for burning, wound for wound, stripe for stripe, *lex talionis* in all its hideousness. He who recruits his shop with scarcely more discrimination, who does not even attempt to find out whether the young applicant is suited mentally and physically for what is to be a life work, who does not attempt to find out whether the itinerant applicant is morally and industrially a fit associate for the other men, an acquisition or a detriment—a near-organizer of this kind must necessarily rely on foremen as arbitrary and undisciplined as himself, must necessarily rely on physical rather than on moral suasion.

The name of Leonidas has thundered down the ages.

When Xerxes invaded Greece with an army of a million men recruited from forty-six nations—almost as many nations as are represented in the great Pittsburg shops—he offered Leonidas the kingship of all Greece, but from the quarreling Greek contingents the King of Sparta selected only 8,000 men. When the pass of Thermopylae was turned through the treachery of a Greek, Leonidas excluded and sent away all his allies except 700 Thespians, and with these and his 300 Spartans remained to do battle as long as one remained alive. The more select the force the greater its efficiency.

When we see ill mannered children we blame the parents, not the children; and on the dreadful Yukon winter trail in 1900 some men maltreated and maimed their unruly dogs until the Northwest mounted police had to interfere, but more carefully selected dogs, showing all the eager soul that Maeterlinck imputes to them, came joyfully jumping around their better master, ready to die at his bidding.

The fair deal, based on the exclusion of the many, the selection of the few, must primarily spring from the master, not from the man. "With what measure the employer metes it shall be measured to him again, therefore all things whatsoever ye would that men should do to you, do ye even so to them." But mere kindliness of heart, mere desire to be fair, does not accomplish anything. Most boys would be better off in a severe school than under their loving, indulgent and weak mothers.

A railroad brakeman was put on the carpet by a superintendent. He came out from the ordeal and exclaimed: "That is the whitest man who ever lived." "Did he reinstate you?" asked his companions. "Reinstate me! No, he fired me; but he talked to me as if he were my father!"

In practice it is difficult to put up a fair deal unless there are three qualities, and these are rarely found in the same person. The qualities are sympathy, imagination, and above all a sense of justice. Though the combination is rare, the difficulty is not insuperable, for many men competent to be leaders through other qualities possess one or the other of the three essentials; and just as an illustrator, a story teller, and a book maker combine to bring out a great book, or even as two authors will combine like Erckmann-Chatrian, one of whom supplied the Gothic mysticism the other of whom supplied the Gallo-Latin lucidity and proportion for a series of great stories of the border land between Teuton and Gaul, so ought it to be possible to have one man, inspired with sympathy, furnish his altruistic dough; to have another man, inspired by imagination, mould it and bake it into bread; to have a third man, inspired by justice, carve and divide that bread so that each receives his own slice.

At Skagway in 1890-91 were many packers carrying the outfits of the northbound crowd over the White Pass. For ten miles out of Skagway the road was easy, and then for thirty miles over the pass and down the head streams to Lake Bennett it was desperately hard. After securing a contract the common run of packers had just enough imagination to move an outfit the first ten easy miles, there dropping it and returning for another cheap contract. The prices these near-swindlers received were low, since they bid against each other for an easy start, accepting from $0.08 a pound down to $0.04. They had no symapthy with the man whose goods they had dumped before the real work was begun; they had still less sense of fairness, anxious only to take money and not to perform the expected work. A type of a different kind was George Brooks who contracted to deliver outfits at Lake Bennett, 40 miles away, in 48 hours or no pay. George Brooks charged and received $0.20 a pound. He must have been a sympathetic man, for everybody liked him; he had imagination, for he knew that what the most eager men supremely desired was to make progress; and, charging the highest price he fulfilled his contracts. In spite of $0.20 a pound George Brooks was respected, honored, and even loved. In spite of $0.05 a pound, the cringing horde of near-packers was despised and loathed.

That builder of an imaginary wagon road up the White Pass who induced a Secretary of the Interior under President McKinley to give him a charter to charge toll at the rate of $40 a ton had imagination, but neither sympathy nor sense of fairness; and that Secretary who thus gave to one man for an imaginary wagon road from White Pass up to Summit Lake the right to levy in perpetuity $40 a ton on the prospective 40,000 tons annually going in, had neither imagination, sympathy, nor a sense of fairness. Nobody objects to great reward for great service. It is the insignificant charge for no service that galls. It is great charge for misrepresented service that enrages.

Most good citizens desire to see natural resources conserved, desire to see Alaska well administered, desire to see smuggling stopped; but the great blunders of an ignorant and self-righteous officialdom at Washington and elsewhere which takes tithes of mint, anise and cummin and omits the weightier matters of the law, judgment, mercy and faith—which strains at a gnat and swallows a camel—make many a man regret that the opportunity of 1776 cannot recur. From the government down, through many of the great corporations and labor organizations, there is conspicuous absence of the fair deal.

The successful gambler, the successful prostitute (history rings with the names and fames of both), succeed because they overbalance the hideousness of their callings with their appeals to the imagination, to the sympathies, to the sense of fairness. Let us therefore approach the principle of the fair deal with our imagination, our sympathies, our sense of fairness alert.

The great bulk of the population of the United States, both relatively and numerically, a hundred years hence will be descended from those who are the wage-earners today. What our industrial officers make now of the working army, not Dreadnaughts and fortified canals, will make our future nation. The wage earners are our people and our nation; if not its backbone and skeleton, if not its brain, nevertheless its living flesh and blood. Moreover the burden on them is both exalted and heavy. It is the men closest to their bread and butter who generally have correct instincts as to evils even if they often flounder as to remedies. It is the flesh that quivers with physical pain, not the brain nor the skeleton. It is on these workers that the duty devolves of bringing up respectable families on a small and precarious income. There is not room for all at the top, even if all were competent to climb, and one of the great problems is to make today bearable without taking away the hope of a better tomorrow.

A boy apprenticed to a trade ought to feel confident that he has not been allowed to enter a race in which even before he started he was hopelessly outclassed; he ought to see before him a reasonable certainty of tenure of position, of definite and increasing wages per hour until he has reached a maximum for his trade and locality; he ought to be assured of decent helpful companions; he ought to be certain that all those things essential to his health and safety which he cannot do himself were being done for him. As to the man, the worker, without whom industry would collapse, all conditions ought to be standardized. Drinking water ought to be germ-free, life-destroying dust should be sucked away, safeguards should surround moving machinery, work illumination should be adequate, not ruinous to eyesight. Working hours should be reasonable and without overtime except in great emergencies, means should be provided for ascertaining directly his needs, his wishes, of listening to his recommendations.

These general welfare considerations have their effect on the contentment of the worker and not one of them is recommended from any patronizing or altruistic motive. A locomotive or other machine is cleaned, housed, kept in repair, given good fuel and good water because its effiiency is thus increased; and in the interests of plant efficiency men should be treated at least as well as we treat machines. It is for mutual, not one-sided, benefit that the workers' counsel is considered.

For many years I was one of the army of workers for a great and progressive western railroad, the "Q" as we fondly called it. I was free to go at any time to the general manager and tell him what I thought of things, of the grade crossing here, of the freight rate that was driving farmers to haul their wheat in wagons instead of shipping it, of the frontier region that needed advances of seed if crops were to be raised the next season. I was one of many paths of communication between this great manager and the people who at once made his road and were dependent upon it. I then came east and lived on the greatest of eastern railroads. I tilted one dark night against the point of one of its crossing barriers. The hurt, severe as it was, enraged me less than the knowledge that I might as well try to change the position of the fixed stars as unofficially to induce a change in a crossing barrier.

Today when at one of the great railroad terminals in New York I walk carrying a heavy grip, 600 measured yards from front of station to car in which I am to ride; when I have to employ two porters, one a street rover to carry the grip 300 yards to the gate, the other a red-capped part of the organization to carry it the other 300 yards; when I am charged extra on every ticket on account of the privilege of using this palatial terminal—it is not these hardships and grievances that exasperate me, but the knowledge that countless millions of other travelers through all the years to come will have to submit unheeded to the same impositions which spring from lack of imagination, lack of sympathy, lack of sense of justice; and this insignificant matter becomes in the multitude the inspiration for an anti-railroad crusade for which the railroad officials are alone to blame—an anti-railroad crusade as to other matters, which would never have arisen if we could trust instead of fear, a hostility often as unreasoning as the little mistakes and injustices are senseless which stimulated it.

A great railroad superintendent of motive power now at the manufacturing head of one of the largest corporations told me that no unreasonable demand had ever been made on him by a labor organization that he could not trace it back to some act of petty injustice by a foreman of poor judgment.

A French Canadian worker at Montreal in a shop of mammoth proportions, fitted with latest machines, remarked with good natured sarcasm: "It is to be regretted that the distinguished management has not considered it among its obligations to furnish such facilities as would make ordinary decency possible among its employees." Workers do consider and reciprocate as to high or low treatment, but it is not such questions as warm shops, clean towels, filtered water that most deeply and directly concern the man. He is willing to work in dripping and dangerous mines, to work in stifling sweat shops, to take his life in his hands every day provided the wages are tempting. It is about wages, directly or indirectly, that most serious disputes arise. When the French Canadians struck in this Montreal shop, it was not for facilities that would promote decency; it was for more wages, more pay.

It is for this reason that wages loom up as the most important question in industrial life today. The individual is born with the instinct of self-preservation, of race-preservation, of acquisition and hoarding, the latter probably merely a specialized development of the squirrel's nut hoard, the wolf's buried meat. We have interposed the device of wages between basic need and its satisfaction. Wages therefore acquire the importance of both, and wages are also the cushion between anarchy and civilization. Men and women twenty-four hours without food become wild beasts; the human baby becomes fretful and then an anarchist if there is ten minutes delay, instinctively knowing that nature gave it a mother able instantly to satisfy its craving. We have societies for the suppression of our natural instincts, societies for the prevention of cruelty, for the preservation of birds, for safety appliances, for art collections and for libraries; we have in our legislature, endless debates over insignificant matters; but where is there any rational study of wages, much less any society to enforce fair wages or any legislation in favor of fair wages? Labor unions use the big stick to force wages up, employers make secret combinations to keep wages down, as if a clock, either too fast or too slow, were any good.

Education and form of government are not nearly as important. No other subject is so disturbing, requires so much of the "fair deal." If plans for wage amelioration, successfully tried on a large scale have been at best only experimental, they at least have interest as showing how this delicate subject was approached with the fair deal in mind.

The worker wants as high pay as he can enforce; the employer wants his output to be as cheap as that of his competitors, for if it is not he will be driven out of business. The worker cannot be expected to work for an employer for less pay than is paid under similar conditions for the same class of work by another employer. The wage payer cannot be asked to pay higher wages than the current rate. Because this question is a dangerous explosive, because any stray spark, concussion, or blow may set it off, it should be as far as possible standardized and nine-tenths of the opportunities for clash be eliminated.

As at present paid, wages come neither under status, contract, nor individual effort. Like many other innovations, wages have preserved some of the worst features of all three systems and avoided the best.

The worker is in status when he comes, stays, and goes under the orders of the employer. There is, however, no status when he is laid off without pay or his hours are cut down. He contracts his time for a fixed sum per hour, but he does not, like other contractors, agree to deliver any equivalent in output for the pay received. On day rate and even on piece rate he cannot use individual effort to increase indefinitely his earnings. He is partly a partner since the machines belong to the employer.

Piece rates have offered no solution. They were tried in order to abolish status and substitute contract and individual effort. Status cannot be wholly abolished. A shop is more highly organized than a flock of sparrows or gulls. There must be regular hours, there are so many dependent sequences that individuals must conform to the general plan. A piece rate is however an endeavor to establish an output equivalent for money paid.

If a man's wage rate is $0.30 an hour, if it is estimated or guessed that he can do a certain piece of work in an hour, a piece rate of $0.30 is established. He is told to go ahead on the supposition that he will earn more than $0.30 an hour. The employer would be very careful how he attempted to reduce this rate per hour, but if he finds that the worker earns $0.50 an hour he immediately begins to scheme to reduce the piece rate.

When high-speed steel began to come into use, the machine shops at Roanoke of the Norfolk & Western were on piece rates under an agreement. Although the use of high-speed steel on modern wheel lathes has reduced to one hour the time of tire turning which was 18 hours with carbon tools on an old lathe, the machinists refused to permit readjustment of the rates.

It is evident that piece rates installed twenty years ago must be inequitable today.

On the one hand, wages have risen with the increased cost of living. On the other hand, improved facilities have greatly increased the ability to turn out work. Piece rates must necessarily be readjusted and their readjustment is one of the industrial tugs of war.

As to this most delicate of wage questions, peace and harmony have followed the following fair deal provisions.

1.—Decimal wage rates per hour are established.

2.—These decimal wage rates run as local conditions require, from $0.20 an hour down and up in two full cent intervals, therefore $0.16, $0.18, $0.20, $0.22, $0.24, $0.26, etc., perhaps down to $0.06 and up to $0.60 or more.

3.—The wage rate at which a man is engaged or retained is subject to negotiation and agreement between him and the employer.

4.—Men shall not be required to work over ten hours a day without a bonus.

5.—Normal hours shall be nine a day.

6.—A time equivalent shall be determined for every operation.

7.—No worker is under any obligation to attain the time equivalent. His wages do not depend on it, but on the time he is under orders.

8.—Time equivalents are subject to revision either up or down as conditions change, never because of high individual skill.

9.—Revision is made by competent disinterested specialists and both parties know why, when, where, and what revisions are made.

If all these provisions are part of the standard practice of the shop, if they are accepted when a man contracts his time, serious disagreements can arise only as to (3). It is inevitable that wages will from time to time rise or fall, partly because of varying cost of living, partly because of supply and demand. In certain districts in Alaska, owing to both causes, wages have been as high as one dollar an hour, and when the Klondike gold rush began, nearly all the miners at the great Treadwell Mines near Juneau simply departed. They made no demand for higher wages, realizing that an increase could not be granted, and what they wanted was not an increase of 10 per cent on a $0.30 rate, but a chance to earn $10 to $15 a day.

Standards could, to a large extent, automatically govern promotion from one class to another on account of gain in experience, increased age, or meritorious record. A time ought to come when a wholesale advance or recession in basic rate could be referred to arbitrators or advisory commissions so as to minimize opportunity for disagreement.

The other eight provisions are almost self-evident. Undecimal rates, as 19 4/9 cents an hour, are an abomination and without permanent excuse. At one great establishment where the efficiency of the men in many instances was below 50 per cent, where it averaged no higher than 60 per cent, where an easily to be obtained increase in efficiency of 20 per cent was apparent, the most strenuous and indignant objections were made to standardizing this rate at $0.20. Rates of $13.50 per week divided by 56 hours to find the hourly rate are also an abomination. The greater accuracy of records and the greater accuracy of supervision far more than offsets the slight cost of standardizing upwards irregular rates, even in an old shop.

Since the United States adopted a decimal dollar, I believe in 1804, it does seem ridiculous constantly to revert to quarters and eighths of dollars, or to advance a man a half-cent per hour, or, what is worse, give him an increase of $0.25 a day for a nine-hour day. Calculating machines, wage tables, are only half as large on a $0.02 interval basis as on a $0.01 interval. If a boy is advanced from $0.10 an hour to $0.30 in ten years he can just as well be advanced in two-cent steps as to be advanced in one-cent steps, and the advances can be so timed as not to decrease his aggregate earnings.

It is conceivable that a man working 8 hours can do a full rational day's work. The same work could be done with less wear and tear in 9 hours. Would I prefer to walk 3 miles an hour for 9 hours, or to walk 3.375 miles an hour for 8 hours? I think I might prefer to walk 2.7 miles an hour for 10 hours. A normal work day of 9 hours with temporary variations in gangs between 8 and 10 hours has been found to work well. If, in balance with the shop, a ten-man gang is working 9 hours a day and one man drops out, until he returns or can be replaced the gang must either work harder, work longer, or disturb the balance of dependent work. Rather than drive harder it is more equitable to pay for the extra normal time required.

Longer hours than 10 are wholly deleterious to both worker and shop. I never knew any advantage to result from promiscuous overtime. It should always be a serious emergency resource, and the bonus should be very high to men and loss of shop efficiency be chargeable to all officials.

The time equivalent for every operation is the key that eliminates misunderstandings. All the great exchange business of the world is today down on a basis of equivalency. A bale of cotton, a bushel of wheat, is standardized at so many pounds and the dollar is standardized at so many grains.

The worker is selling time, just as a coal-mine operator sells coal; but the purchaser is not buying time nor coal; he buys output and heat units. The equivalency between operation and time (not wages) is of transcendent importance, exactly as equivalency between heat unit and fuel is of importance. Happily both can be scientifically and accurately determined, and even if we never realize the equivalent, the starting point for our modern engines and their improvement over their prototypes of fifty years ago is that we know that 776 foot pounds are the equivalent of an increase in temperature of one degree F. of one pound of water.

No maker of an engine is under obligation to realize this equivalent. Neither is any worker under any obligation to attain a time equivalent. His wages do not depend on it. He is paid just the same whether he ever realizes a single equivalent, even though in every case they are equivalents that under standardized conditions and standardized operation are normally attainable. One hundred yards in ten seconds is not a normal equivalent; four miles for a single hour, twenty miles a day for six days each week, are normal equivalents.

Owing to changed conditions, never owing to wages, equivalents to remain fair equivalents must be revised. When a miner of precious ore wishes to sell, when a smelter wishes to buy, neither takes the word of the other. Both employ skilled and certified assayers who assay from the same sample of the ore and determine its value, and if they do not agree other assays are made; on these scientific assays millions of dollars are paid out with never a question or dispute. If accounts between two mercantile firms are muddled, a certified accountant is called in who unravels the truth and on his statement settlements and even court awards are made. Similar revision of equivalents, although no wage rates are involved, should be made by scientific specialists, employing scientific methods, revising solely in the interest of accuracy and truth, never to give either party an unfair advantage. All these provisions have been applied, and applied successfully, on a large scale if not completely all in the same plant. They have worked as intended, they have eliminated wage disputes and wage disagreements, since the inculcated habit of fairness has reacted on the basic wage question and the employer particularly has proved willing without demand to raise the basic rate. The vice-president of a great railroad system of 10,000 miles who has applied many of these provisions to the wage question states as one of his guiding principles that if other roads in his territory increase rates so as to equal his rates, he will at once make a readjustment upward of the basic rates in order to maintain a differential in favor of his employees.

It is unfortunate that the worker concentrates his attention on the rate of wages instead of on what they secure for him. It may be well-nigh impossible to force wages up 20 per cent but it is well known that a French family can live in plenty on what an American family wastes. I know a man, now a millionaire, who at the age of thirty-five was still working for $40 a month as a beef carrier in Chicago. He saved money and bought a farm, sold the farm and went into the milling business. I know another man, now a millionaire, who started as a carpenter, built breweries, saved money until he had a brewery of his own. I know a young man now chief assistant to the executive of a great plant. On a salary of $30 a month he married a thrifty Scotch lassie and the dimes they saved from the start seemed as large as cart wheels.

If the American worker would put efficiency into his family expenditures his income would go 50 per cent further. It is unfortunate that he concentrates his attention on rate of wages instead of on the equivalent he is giving the employer. It is unfortunate that the employer shies at the suggestion of a 10 per cent advance and pays scant if any attention to a 50 per cent inefficiency, two-thirds of which is his own fault. The combination of thrifty worker, high equivalent, fair-minded and progressive employer, wages far above the average, insures lowest costs, just as certainly as piano wire at a high price per pound will make a stronger, longer, bridge than cast iron at one cent a pound.

Like the other efficiency principles the fair deal should be standardized; it should be moulded by each of the other eleven; it should be under the particular care of a very competent staff official. Provided for in the organization, founded on ideals, on common-sense; developed by competent advisers, simplified by vigorous exclusion of the unfit, the unfair, it should be carried into effect through reliable, immediate and adequate records, through standard practice, definite instructions, through schedules and through all the other efficiency principles.

The fair deal is the last of the five altruistic principles, principles so fundamental that we find them applied by a she-bear to the bringing up of her cubs; principles inculcated by Old and New Testament, inculcated by every great religion.

Benjamin Franklin made a list of thirteen different forms of carelessness into which he knew he would insensibly drift unless he put forth special effort, so each week in each quarter year, he daily observed himself as to one of the thirteen and braced up. Four times a year, for many years, he went through this routine until theory had become habit. The object of collating wise practices of administration under a few simple heads is that each may regularly survey his own task from the point of view of each one of the principles, and thus not only prevent the backsliding that ultimately results in disaster, but make forward progress so that he who started as a disciple soon becomes a master to whom we turn for competent counsel.

The next five principles, (therefore not including the last two, standardized operation and efficiency reward,) are not practiced by the she-bear, are very inadequately inculcated by the great religious teachers.

They are as modern as the gas engine, the dynamo, the steam turbine; they are almost as modern as the flying machine; they are evolved to cover modern complex conditions. The sequence in which they will be discussed is not essential. Records will be first considered, but records can be neither reliable, immediate, nor adequate until nearly everything else has been standardized. The subject of records will therefore, of necessity, be treated theoretically, showing at least the backbone of essential records from which less essential records spring like ribs. There are records of standard condition, of standard operation, records of discipline and records of the fair deal; but the essential records of cost and efficiency will be developed from an underlying, universal and exceedingly simple formula, which covers operating efficiencies and stardard operating costs of materials, of men, and of installation.

EDITORIAL COMMENT

The Latest Transatlantic Steamship.

WITH the launch of the Olympic the White Star again took the lead among the mercantile fleet owners of the world as possessing the largest ocean carrier. The Ismay traditions have been fully maintained in this splendid accession to its transatlantic liners. But present-day ambitions of ship-builders do not rest content with the achievement of a single vessel. The construction of duplicates or alternatives is seen to be real economy by lessening the risks and losses of break-downs and delays. In the case of the Cunard sister ships, the Mauretania and Lusitania, the interchangeability of parts in the machinery has been found to save time in repairs and to afford other advantages and safeguards. The Olympic is even more fortunate in that her twin, the Titanic, has been built by her side on the Belfast stocks and it has therefore been a comparatively easy matter to work out the designs of both ships together. What better example could be given of prevision and engineering organization as applied to the shipwright's art and practice than in the Harland and Wolff yards for this gigantic undertaking!

That at the critical moment the mass of 27,000 tons glided into the water in sixty-two seconds without the slightest hitch was a compliment to the perfection of the arrangements by which ships approaching a thousand feet in length are nowadays set afloat. Since the foundation of the White Star line forty-one years ago Harland and Wolff's have been responsible for the construction of the Ismay ships, the Cedric being an exception. The pioneer vessel of the fleet was the first Oceanic, which made her first voyage to New York in March, 1871. She was 430 feet long and of 3,807 tons. It is interesting to note that the launching apparatus employed for the Olympic 882½ feet long and 92½ feet broad was much the same as that employed for the launch of the Oceanic in 1899. That ship of 17,274 tons and 705½ feet long eleven years ago considerably exceeded any vessel then built or building. It does not seem that the trigger arrangement for releasing the ship cradle has been improved upon in the time which has seen the development in size of vessels measured by the Olympic and Oceanic relatively. An idea of the enormous weight involved is realized perhaps more fully by the fact that the rivets in the completed ship number about three millions weighing 1,200 tons. The Olympic rudder itself has a weight of 100 tons and the engine crank shafts are 118 tons each. Such good performances had been given by the Laurentic that the owners and engineers had little hesitation in adopting for the Olympic the combination system of propulsion by high-pressure reciprocating engines and low-pressure turbines.

In the keen rivalry that exists between the British and German lines for the supremacy of the Atlantic it would be futile to suppose that the development of engines is nearing the general acceptance of any standard type. The Olympic will enter into the race next year, with the prospect of even larger and more powerfully engined vessels soon to be pressing on her heels. But her record size for the time being will force to an immediate issue considerations of docking facilities both in the channel and at New York.

Built primarily for comfortable passenger service it would be a drawback to the special accommodation given in such ships as the Olympic for these big vessels to be debarred from landing travelers in the heart of New York city by want of adequate piers though the waterways are entirely suitable. Southampton has set its dock engineers to work to provide safe berths for these giants of the ocean. It will be strange if New York does not similarly adapt its naturally advantageous water front to present and future needs without necessitating the inconveniences that would be inseparable from disembarking at such a distance from the city as Montauk Point.

The Commercial Motor-Vehicle.

AMONG the engineering societies which began their winter's sessions with inaugural addresses the Institution of Automobile Engineers was distinguished by the valuable review of motor-car development made by its president, Mr. F. W. Lanchester. The pleasure or passenger motor-car's status is well assured and the fifteen years of development in the modern period have resulted in standardization according to one general plan of construction. Manufacturers are now concentrating their attention upon the motor car intended for commercial and business purposes. Mr. Lanchester confessed that some years ago, after investigating the difficulties that beset the substitution of motor vehicles for horse traction, he was reluctantly obliged to give the advice to continue with horses as no saving was then to be expected from the change. Apparently he is not much more hopeful now, and certainly does not have the optimism of Mr. Edison, who would be content with little less than the complete banishment of the horse from the streets. When even the brewer's stable, however, is not being kept up but the best dray-horses are being replaced by the motor in wagon, truck, and light van the change is taking place more swiftly and steadily than is apt to be noticed.

On all hands it is anticipated that the next big expansion of the automobile industry will be in the direction of the heavy commercial vehicle. Mr. Lanchester, concurring in that view, lays stress upon the two main factors that check a rapid transition to the general run of the commercial motor car. The cost of materials, especially fuel, is a serious obstacle particularly owing to the market fluctuations. The motor car is the result of the combination of a number of modern inventions, recently utilized, or natural products like aluminium, caoutchouc rubber, and mineral oil used both as fuel and lubricant. The range of prices of these factors has a much more important bearing on the successful manufacture of the commercial motor-vehicle than of the pleasure motor-car which is primarily a luxury, and uncertainties as to the price of these materials have caused many miscalculations and disappointments for the manufacturer. It looks, however, as if the three articles mentioned may all be cheaper in the future. Aluminium since 1900 especially has declined in price by more than half. Rubber has, according to the best judgment, reached its zenith in price and in two or three years there need be no fear of short supplies. The opening of new oil-fields also promises benefit from fresh competition.

In the probable mechanical improvements Mr. Lanchester looks for further reduction of vibration and for better self-starting apparatus, but for no revolutionary change from the present accepted type. After all is said and done, however, the second main factor in bringing the commercial motor-vehicle into universal use is good roads. Here the road engineer controls the situation.

REVIEW OF THE ENGINEERING PRESS.

"THE WORLD IS ITS FIELD"

A YEAR'S PROGRESS AT PANAMA.

A REVIEW OF PROGRESS IN EXCAVATION AND CONSTRUCTION DURING THE YEAR ENDED JUNE 30, 1910.

Annual Report of the Isthmian Canal Commission.

THE impression of effective activity and rapid progress left by the perusal of Mr. Fullerton L. Waldo's record of personal observation of the work on the Isthmus, published in THE ENGINEERING MAGAZINE for October, is substantiated by the annual report of the Isthmian Canal Commission for the fiscal year ended June 30, 1910, which has just been released for publication. We give below a brief abstract of those parts of the report which deal with the progress made in excavation and construction, and we would refer our readers, for a *resumé* of the state of the work at the end of the preceding fiscal year, to a similar abstract published in these columns in our issue for December, 1909. On page 388 *et seq.* of this issue will be found a number of interesting photographs illustrative of certain features of the work.

The general designs of the upper locks at Gatun and of the locks at Pedro Miguel were described in the annual report for 1909. During the year covered by the last report, the engineering force has been engaged in the preparation of detailed drawings for the construction of these works, and in the development of the general plans for the intermediate and lower locks at Gatun and for the flight at Miraflores. In the lock designs has been included an approach wall in prolongation of the wall separating the twin locks, against which vessels are to moor, the wing walls being judged unsuitable for this purpose. Contracts have been let for all the frames for the gate valves required to control the main culverts for the upper Gatun and Pedro Miguel locks, for the frames and moving parts of two sets of Stoney valves, and for the forty cylindrical valves required for the two locks under construction. The contract has been let also for all the gates required to equip all the locks when completed, at a price of 3.785 cents per pound for structural steel erected, 2.62 cents per pound for steel not erected, and $5,374,474.82 for the entire work; the erection of the 46 gates, or 92 leaves, is to be completed by June 1, 1913. The electrical machinery for the operation of the Stoney gate valves and the cylindrical valves has been completed, and careful study has been given to the design of the machinery for operating the gate leaves. For the spillway dam at Gatun a general design has been adopted, which calls for a dam semicircular in trace, and in cross section an ogee, made up of an arc of a parabola, a tangent, and an arc of a circle. The crest of the dam is divided into 14 bays, 45 feet wide, closed by means of Stoney gates. When the lake is at plus 87, one bay with the gates fully opened will discharge 11,000 cubic feet per second.

At the site of the Gatun locks, the excavation for the upper locks, and for the intermediate locks with the exception of the trenching required for the lateral culverts, has been completed. On June

30 last, 375,000 cubic yards remained to be excavated for the lower locks. In the lock chambers the excavation during the year has amounted to 3,965,699 cubic yards in the dry, and 435,178 cubic yards in the wet, and in the auxiliary work to 646,520 cubic yards. The average cost of excavation, during the six months ended June 30, was, including all charges, $0.6751 per cubic yard. The concrete mixing and handling plant described in the annual report for 1909 gave considerable trouble when first installed, but since April has operated without difficulty. The total amount of concrete laid during the year was 513,803 cubic yards, at an average cost per yard in place, including all charges, of $7.355. To complete the Gatun locks, including the approach and wing walls, 1,532,297 cubic yards of concrete remained to be placed on June 30.

At the site of the Gatun dam, at the close of the fiscal year, the north and south toes of the portion of the dam east of Spillway Hill had reached an elevation of 65 feet above mean tide, and the hydraulic fill between the toes, an average elevation of 51 feet. West of Spillway Hill the north toe has been carried to an elevation of plus 30, and the south toe to an elevation of plus 35. The total amount of material placed in the dam during the year was 2,577,234 cubic yards of dry fill, estimated on car, and 2,933,175 cubic yards of hydraulic fill. The average costs for the last six months of the year were 28.19 cents per yard for dry fill and 32.54 cents per yard for wet fill. Excavation for the spillway resulted in the removal of 127,210 cubic yards, which completed the excavation for the floor, for the curtain and side walls, and for nearly the whole of the foundation of the spillway dam. In the floor and side walls 53,632 cubic yards of concrete was placed, at an average cost for the last six months of the year of $8.602 per yard.

Work was begun last March on a levee 1½ miles long, connecting Spillway Hill with Mindi Hills, which is to close the French canal to access of the waters of the Chagres River passing through the west diversion. This levee will prevent the recurrence of floods such as caused the suspension of excavation in the Mindi section on November 20, 1909. The excavation in this section during the year amounted to only 91,572 cubic yards of earth and 233,144 cubic yards of rock. The average cost was 62.18 cents per yard. At the time work was suspended the deepest part of the cut had reached a depth of 42 feet below sea level.

The dredges in operation between the Mindi Hills and the Caribbean during the year removed a total of 4,556,375 cubic yards of earth and 399,285 cubic yards of rock from the canal prism, at an average cost of 23.60 cents per cubic yard. The dredges handled also 3,206 cubic yards of earth from approaches to the Gatun docks, 69,844 cubic yards of earth and 55,036 cubic yards of rock from the French canal, 247,537 cubic yards of earth and rock from the Cristobal terminals, and 501,928 cubic yards of earth and rock from the approach channel leading from the canal to Cristobal Harbor. The silting between miles 1 and 3 amounted during the year to 955,287 cubic yards; the total fill is estimated at 3,500,000 cubic yards. The breakwater running out to 44-foot depth in Limon Bay was definitely located in March last, as was also the canal channel through these waters.

In the Chagres district the work of cutting through the 23 peninsulas formed by the tortuous course of the Chagres River, designated, from Gamboa, Points 1, 2, 3, etc., has been continued. The completion of the cut through Point 2 was reported in the annual report for 1909. Work on Point 1 was completed May 28, 1910, with the excavation of 1,246,761 cubic yards (286,560 yards during the last year). At Point 3, 832,646 cubic yards were removed; at Point 4, 10,646 yards; at Point 5, 23,824 yards; at Point 6, 46,741 yards; at Mamei, 372,671 yards; at Caimito, 338,675 yards; at the Cano River cut, 707,031 yards; at Tabernilla, 393,490 yards; at Buena Vista, 153,026 yards; and smaller quantities at other places. The total amount removed from the Chagres section from the beginning of operations to the close of the last fiscal year was 9,497,673 cubic yards, leaving still to be excavated 3,415,944 cubic yards.

During the fiscal year 14,921,750 cubic yards were excavated from the Culebra cut, leaving 34,893,531 cubic yards to be removed before this section is completed. This amount includes an increase of 6,408,560 yards over the estimate made in September, 1908, a part of which is to provide for the widening of the canal north of Pedro Miguel lock, but the greater portion to allow for slides and breaks. In addition to the slides, which have always been troublesome, a number of breaks have occurred in the banks of the canal. The largest break, on the west bank of the canal at the town of Culebra, covers an area of 10½ acres; from this break 1,500,388 yards were removed. From another break directly across the canal 314,184 yards were removed, and still another break has occurred at La Pita Point. Cucaracha is still the most important of the slides; 639,239 yards were removed from it during the year. The slides at New Culebra, Whitehouse, and other points were active also. The total amount of material removed from all slides and breaks in the central division during the fiscal year was 2,649,563 cubic yards, or about 15 per cent. of the amount removed from the Culebra cut. The average cost of excavation for the year was 66.99 cents per yard.

At Pedro Miguel, work was continued in excavating the lock site and the approaches from the south. Two slides increased the amount to be removed by 75,299 cubic yards of earth and rock. The total excavation was 343,448 yards, at an average cost of $1.188 per yard for the 279,364 yards of excavation proper. In preparation for the foundations 64,084 yards were removed by hand at a cost of $2.8193 per yard. The plant for the construction of the locks was installed and a total of 166,869 cubic yards of concrete was laid at an average cost of $6.089 per yard. The total amount of concrete required is 858,600 cubic yards. Filling back of the west wall was begun about June 1, and by the end of the month 9,616 cubic yards had been placed. Within the year, 51,827 cubic yards of material has been added to the impervious portion of the west spoil dam, and 41,964 cubic yards to the toes, at a cost of 38.6 cents per yard. The material was largely derived from the excavation of the canal prism below the Pedro Miguel lock site, where 99,703 yards were removed at a cost of $0.6345 per yard.

The excavation for the upper locks of the flight at Miraflores was practically completed during the year, and the work of preparing the foundations, erecting concrete plant, and placing concrete began. The total amount excavated was 293,829 cubic yards, at a cost—for the last six months—of $1.369 per yard. Of this amount 157,483 yards was placed in the toes of the Miraflores west dam, and 121,080 yards was used as back fill. A 20-inch suction dredge worked in the lower lock site until late in December, 1909, when it was removed on account of the unsatisfactory conditions. Its total output was 141,759 cubic yards at an average cost of 50.63 cents per yard. The remainder of the material will be excavated by hydraulic means.

The work of preparing for foundations in the upper locks was done by steam shovel and by hand, the 24,655 yards of steam-shovel excavation costing $1.947 per yard. The total amount of concrete laid during the year was 1,630 cubic yards, at an average cost of $7.393 per yard. The estimated amount of concrete required for the locks, including approaches and wing walls is 1,327,300 cubic yards. Power for the operation of the construction plant at Miraflores, for the crusher plant at Ancon, and for the sand unloading cranes at Balboa is furnished by a power station which was finished during the year at a total cost of $486,096.82.

The west dam, extending from the head of the locks to Cocoli Hill, consisting of two mounds or toes made up of waste material obtained from lock excavation, mostly rock, and of hydraulic fill between them, received during the year 157,483 cubic yards of material in the toes, at an average cost of $0.6774 per yard, and 120,910 cubic yards of impervious material.

The material to be removed in the two-mile stretch of channel below Miraflores locks amounts to about 9,650,000 cubic yards, of which over 1,500,000 is rock, Lack of a sufficient number of dredges has led to the adoption of hydraulic methods for the removal of the earth. South of the area to be excavated by hydraulic means, the necessary depth and width of channel will be secured by ordinary dredging operations. The total output of the dredges which worked during the last fiscal year was 6,914,384 cubic yards, at an average cost of 24.08 cents per yard. The rock is prepared for handling by the dredges by drilling and mining, subaqueous blasting, and rock breaking.

The appropriations made by Congress for the Isthmian Canal and available to the close of the fiscal year 1909 amounted to $210,146,468.58, or 56 per cent. of the total estimated cost of the canal, which is fixed at $375,201,000. On June 25, 1910, $37,855,000 were appropriated for the fiscal year 1910-11, leaving $127,199,531.42 of the estimated total cost of the canal to be appropriated. The total classified expenditures for canal work to June 30, 1910, amounted to $191,258,113.93, of which $31,188,426.37 was the net expenditure during the fiscal year covered by this report. Of the total classified expenditures to June 30, 1910, $25,699,450.81 were for plant and equipment for construction work, of which $4,388,511.55 were expended during the fiscal year.

THE FRENCH RAILWAY STRIKE.

A REVIEW OF RAILWAY CONDITIONS IN FRANCE, THE CAUSES OF THE STRIKE, AND THE SIGNIFICANCE OF THE RESULT.

The Engineer.

THE significance of the recent strike of the railway employees in France lies in the fact that to the strike promoters the improvement of the condition of railway labor was a secondary consideration. Fundamentally the contest was not one between labor and capital, but between militant socialism and the authority of Government. The strikers were completely under the control of the Confédération Générale du Travail, and were used merely as a tool to further the revolutionary schemes of that organization. Although the failure of the socialist agitators to attain their ends was complete, disastrous consequences to the State were very narrowly averted, and the whole history of the strike offers the clearest possible exposition of the perils besetting a Government which accepts, to the extent to which it is accepted in France, the principle of Government ownership or control of public utilities.

"The strike of the railway men in France," says an editorial in *The Engineer* for October 21, "offers the strongest condemnation of the system of State control of railways. To understand the cause of the strike it may be necessary to explain the conditions under which railway enterprises are carried on in France. Being an essentially military country it is desirable that the Government should exercise a certain control over the railway companies to ensure that they are always capable of transporting the maximum number of troops at almost a moment's notice. If the control were limited to this supervision there would be no reason for complaint, but the French Government carries its interference much further. It should not be overlooked that the companies exist on sufferance—that is to say, their concessions are held for a certain period, after which the lines, with their equipment, descend to the State. In the meantime the railway debentures are guaranteed by the Government, which has for many years been paying interest on such stock of certain companies. There is consequently a very close association between the companies and the State, to the extent even that the companies can do nothing without the sanction of the Minister of Public Works. No permanent construction can be made, and no improvements carried out, before the plans and the expenditure have been approved by this department. Railway fares and traffic charges have to be submitted in the same way. It may, indeed, be said that the companies are merely running the lines in trust for the State.

"To imagine the situation created by thus subordinating the railway companies to the will of Parliament is easy. In a country so strongly dominated by the Socialist element the Government is continually exhorted to adopt 'democratic measures,' which, in the case of the railway companies, means the fixing of low third-class fares, and the compulsory running of unprofitable services to satisfy the demands of deputies from districts where the traffic has not justified the companies in putting on more trains. Then there is the abuse of free passes, which have to be accorded to all the deputies, senators, and civil servants, as well as to all sorts of people who have sufficient political influence to enable them to travel free. These are only a few of the burdens under which the companies labour, but they are sufficient to show that the companies do not possess that freedom of action which is necessary to the satisfactory management of a commercial or industrial enterprise. Finding their receipts seriously curtailed by these political exigencies, the companies have been obliged to effect economies wherever possible, and there has consequently been some delay in giving satisfaction to the railway men over the question of wages. Nevertheless, it cannot be said that the situation of the men is so unsatisfactory as is represented in the manifesto which was prepared by the strike committee for the public edification. The men are claiming a minimum wage of 5 francs a day, and it is asserted that on some lines the minimum wage is only 3.50 francs a day, which, naturally, would be wholly insufficient in view of the higher cost of living for the men in and around Paris. To this sum, however, which is represented as the minimum wage, must be added various other pecuniary advantages which finally bring the total amount paid to the men to a much higher figure. The minimum wage, being based upon the cost of living in country districts, is increased by an indemnity to men who live in and around Paris, and in addition to this, a certain amount is allowed for families, which, on the State railways, bring the minimum amount paid annually to each man to 1,619 francs. Apart from this, each man has a certain number of free passes for himself and his family over the entire railway system, he is accorded free medical treatment, he is paid during illness, and he is allowed fifty-two days' holiday during the year. Consequently, with a maximum of 314 days a year, he receives a minimum of 5.16 francs, which is about 4s. 1d. per working day. Promotion naturally awaits every man who displays ordinary zeal in the exercise of his duties. On the other lines the situation of the men is scarcely less satisfactory. The companies have for two years past been devoting an increasing sum of money to the welfare of the men, amounting in one case to 4,000,000 francs; but the minimum wage, which was the chief point of conflict, remains in abeyance. As the result of the agitation of the National Railwaymen's Union, the Prime Minister obtained from the companies a promise to consider favourably the men's claims, but before this could be done the long-threatened strike was declared.

"There are probably few classes of workers possessed of less revolutionary tendencies than the French railwaymen, and yet the strike is regarded by the Government as of a distinctly revolutionary character. Here, again, we see the serious inconvenience arising out of the State control of a commercial enterprise of national importance. The strike has been seized upon as a means of destroying the Government and existing social institutions, not by the railwaymen themselves, but by those behind them. . . . . . It may be affirmed that the great majority of railwaymen honestly believed that the strike would be ended in forty-eight hours. The men could not imagine that Paris would stand the ordeal of complete isolation for a longer period. Had the calculations of the strike promoters not miscarried the consequences would have been disastrous. For a time a general strike seemed quite within the range of probabilities. . . . . . Undoubtedly a great factor in preventing the extension of the strike was the calling up of the military reserves forming the Railway Corps. This was a bold step, because, had the men refused to obey, the condition of things would have been little short of anarchy, and this contingency was deemed quite possible in view of the way in which the Union was dominated by the revolutionary element of the Confédération Générale du Travail. Fortunately, the men responded on all the lines except the Nord and the Ouest-Etat, where a large number refused to serve, although the fear of the consequences, together with the conviction that the strike was turning against them, caused an increasingly large number to put in an appearance, until on the Nord and Ouest-Etat the engine-drivers and other servants were in sufficient force to allow of the service being partially resumed. This was the beginning of the end, and every day saw large additions to the ranks of workers, until the Railwaymen's Union was obliged to give in. The whole of the railway system in France is under military mobilisation, exactly as it would be under actual war conditions. Disobedience may be dealt with by court martial, and this, as well as the fear that those who delay their return to work may be discharged, has had the effect of completely breaking down the resistance of the men.

"The significance of this strike lies in the fact that it represents one of the greatest struggles that have yet taken place between militant socialists and the authority of Government. The postmen's strike last year failed mainly because there was a want of sympathy between the men and the revolutionary agitators, and these latter thought they had greater hope with the railway workers, among whom there was undoubtedly a strong socialist element. It is difficult to imagine how the ends of the strike promoters could have been better served than by a complete suspension of the entire railway service. They have fortunately once more failed to attain these ends, and having 'shot their bolt' for the time being, there is every probability of these fomenters of disturbance being reduced to a state of inaction. The Government also has seen the danger of allowing the railwaymen too much liberty in the way of breaking contracts with the companies. Whether the men employed upon a great national enterprise like the railways have the right to strike has long been discussed, and was admitted by the Government, but it is understood that the Government intends to introduce a bill whereby this right will be restricted, especially in the way of intimidating workers who do not belong to the union, or of interfering with those who refuse to strike. The events of the past week have emphasised very strongly the vital part played by the railways in the life of the country. So much has been said about the possibilities of mechanical road locomotion that it was supposed by a large section of the public that railways were becoming less of a necessity than formerly, but the temporary isolation of Paris from North-West France has brought home to the public the supreme necessity of an adequate railway service, and it may be taken for granted that precautions will be adopted in future to prevent a recurrence of such a disastrous strike."

THE GROWTH OF STEAMSHIPS.

A DISCUSSION OF THE INCREASE IN THE SIZE AND SPEED OF STEAMSHIPS SINCE THE *GREAT EASTERN*, AND OF THE CONSIDERATIONS AFFECTING FURTHER INCREASE.

Sir William H. White—Times Engineering Supplement.

LITTLE more than three years has elapsed since the launching of the *Lusitania* and *Mauretania* gave to the world, to quote Harrington Emerson, its seventh modern wonder. The speed of these monster vessels was so great as apparently to discourage all competition, and they remain the undisputed speed champions in the Atlantic, the scene of intense rivalry among shipping lines since the earliest days of steam navigation. In place of the competition for the Transatlantic speed record, however, there has arisen a competition in size of vessels, in which the giant Cunarders are already outclassed. The *Olympic* of the White Star Line, which was launched at Belfast on October 20, and her sister ship the *Titanic*, which is far advanced in construction, exceed the *Lusitania* and *Mauretania* in length by 92 feet, and in gross tonnage by over 11,000 tons. Larger still is the vessel recently ordered by the Hamburg-American Company, and the Cunard Company is reported to be considering the construction of a ship superior in size to any of these, designed to restore to the Cunard Line its lost pre-eminence.

It may well be asked where this competition is to end. Sir William H. White, who discusses the growth of steamships in the *Times Engineering Supplement* for August 31, believes it is impossible to predict what will happen in the future, except that the determination of the limit of size of steamships will be based upon commercial considerations.

	Great Eastern.	*Lusitania* and *Mauretania.*	*Olympic* and *Titanic.*	Hamburg-American Steamship.
Length over all, feet	693	790	882	910
Length between perpendiculars, feet	680	760	850	879
Breadth, extreme, feet	83	88	92½	95
Molded depth, feet	58	60½	64½	64
Draft of water (laden), feet	34	34	34	34
Displacement at load draft, tons	32,000	39,000	50,000	52,000
Gross tonnage, tons	18,915	32,000	43,300	45,000
Horse-power	8,000	75,000 (shaft.)	40,000 to 45,000	60,000
Sea-speed, knots per hour	14	25½	21	22
Type of engine	Combination of paddle-wheels and single screw.	Parsons turbines, 4 shafts.	Combination of twin reciprocating engine and low-pressure turbine, 3 propellers.	Turbines, 4 shafts.

The accompanying table gives the principal data of the vessels mentioned above, and also of the *Great Eastern*. A uniform draught of 34 feet—the deep-load draught of the *Lusitania* and *Mauretania*—has been assumed for all the ships. All the vessels, of course, could be safely loaded to deeper draughts if port facilities were available at all times. This draught, however, is the maximum which can be contemplated for the ports of Liverpool and Southampton, and very close to the maximum for New York, even when the Ambrose Channel is completed. The displacements given in the table are approximately correct for this assumed draught. The figures for horse power are necessarily only estimates, but are very close to the powers necessary for the contemplated speeds.

"The new vessels of the White Star and Hamburg-American Lines represent a great step in advance of the largest Transatlantic steamers of the 'intermediate' type previously built. The *Adriatic* for example, which was launched about the same time as the *Mauretania*, is nearly 726 feet in length (over all), 75½ feet broad, 58 feet deep, 24,500 tons (gross), and is propelled by twin-screw reciprocating engines of about 15,000 horse power at an average speed of 16 to 17 knots. The North German Lloyd's steamship *George Washington*, which made her maiden voyage last year, is about equal in length to the *Adriatic*, is 78 feet broad, 54 feet deep, of 25,500 tons (gross), has engines of 20,000 horse power, and has made passages at an average speed of 19 knots. At a load draft of 33 feet her displacement is said to be about 37,000 tons, and her cargo capacity 13,000 tons. The largest ship of the Hamburg-American Line now on service, the *Kaiserin Augusta Victoria*, was built in 1905. She is nearly equal to the *Adriatic* in tonnage, about 2 feet broader, and 30 feet shorter. The vessel just ordered will be 30 per cent longer than the *Kaiserin* and 80 per cent greater in tonnage.

"From the foregoing figures it will be seen that the last five years have been marked by rapid and enormous increase in the dimensions of steamships, the 'biggest ship' laid down having been speedily deprived of that distinction. The contrast between existing conditions and those which formerly prevailed is remarkable. More than 40 years after the *Great Eastern* began her Transatlantic service (June 17, 1860), she remained unsurpassed in size, although the chief features of her design had been determined by Brunel in 1852-3. Commercially that ship was a failure; from the scientific and technical sides she will always remain a marvel of professional skill and courage in facing new conditions and going far beyond precedent. Until the *Cedric* of the White Star Line was built (1903) the *Great Eastern* was not surpassed. Brunel worked under great disadvantages as compared with his successors of to-day in regard to materials of construction; yet by skilful structural design and close attention to details he produced a vessel in which the weight of hull in proportion to dimensions, displacement, and carrying power compared favorably with the corresponding proportions in the largest steel-built vessels of the present day.

"The last half-century has witnessed great improvements in the materials and methods of shipbuilding and in marine engineering; there is consequently no reason for supposing that further increase cannot be made in the dimensions and speeds of ships if commercial considerations should make that course desirable, and if the necessary financial provision were made for the construction of larger ships and for suitable dock accommodation at terminal ports. Shipowners and dock proprietors, not naval architects and marine engineers, will have to decide where and when increase of size and speed shall stop.

"It has been explained above that the latest additions to the dimensions of ships have been made in vessels of the 'intermediate' type, for which the speeds contemplated are considerably below the speed of the great Cunarders, and are moderate in relation to the dimensions of the ships. The engine-powers and coal consumptions are, of course, much reduced in consequence of the lower speeds accepted, and the vessels will possess much larger cargo capacities than the *Lusitania* and *Mauretania*. Opinions may differ in regard to the probability of this great cargo capacity being fully utilized for most of the voyages made each year, and it is understood that existing ships of the intermediate type rarely find cargoes, even when coming eastwards, which bring them down to their deep-load lines.

"Further increase in the size of steamships would undoubtedly be accompanied by economy in the cost of over-sea transport of cargoes. Brunel understood and clearly stated this law nearly 60 years ago, and it is of universal application when ships are under way at sea. On the other hand, if increase in size and cargo capacity should be associated with longer periods in port, made necessary by the collection, shipment, and discharge of larger cargoes, or if, as a rule, full cargoes could not be secured for these very large ships, the consequent diminution of earning power, together with the increased first cost of the ships, the larger allowances for depreciation and interest on capital, and the lessened proportionate service at sea might outweigh any economies in cost of transport obtained by increased dimensions. In this way it is possible that a limit may be put to increase in size. Moreover, the great expenditure involved in the provision of suitable accommodation for very large ships in docks and harbors is already felt by the proprietors and authorities. Large expenditure has been faced at London, Liverpool, Southampton, New York, and other ports in deepening and widening channels, constructing floating and dry docks, and providing generally for ships of the largest size; but it is possible that on this side also commercial considerations may prevail, and the rapid progress in dimensions of the last few years be checked simply because it is found that, on the whole, it does not pay.

"Increase in dimensions of ships is, as a rule, accompanied by greater steadiness, better behavior, and more uniform maintenance of speed in stormy weather. Speaking broadly, it may be asserted that a point has already been reached where the dimensions of ships in proportion to the lengths and heights of the largest waves are such as to secure the power of maintaining practically uniform performance, and of securing steadiness and good behavior in all weathers and conditions of the sea. Consequently, from the point of view of behavior and the maintenance of uniform speed, no further considerable increase in size in Transatlantic steamships seems to be necessary.

"No doubt it is possible to provide more varied, extensive, and luxurious accommodation in larger ships, and some slight improvement in average behavior may accompany increase in dimensions. Many passengers even now prefer to cross in slower but very comfortable intermediate steamships of large size and moderate engine power; their preference is likely to continue and may ensure satisfactory employment for the larger vessels now building or for still larger vessels. On the other hand, high speed and quick passages will always be sought for by many, if not most, persons to whom time is important. With turbine propulsion it is possible to prevent any sensible vibration and to avoid discomforts such as are inevitably experienced in swift steamers driven by reciprocating engines. Every one who has taken passage in the *Lusitania* or *Mauretania* since their screw propellers have been changed will confirm this statement, and there can be no question as to the possibility of securing equally satisfactory conditions with even still faster and larger vessels.

"In view of what has happened in the past, it is not possible to predict what will happen in future, but it seems certain that commercial considerations will predominate."

WATER VELOCITY IN SURFACE CONDENSERS.

A STUDY OF THE RELATION OF THE VELOCITY OF THE CIRCULATING WATER TO CONDENSER-PLANT ECONOMY.

R. M. Neilson—The Engineer.

IT is well known that the velocity with which the circulating water passes through the tubes of a surface condenser has a decided influence on the economy of the installation. High velocity is conducive to a high rate of condensation and permits the employment of a comparatively small area of cooling surface; but, on the other hand, high velocity involves a large expenditure of power for pumping and necessitates the employment of a powerful pump and driving motor. Above a certain velocity the beneficial effect of increased rate of condensation is relatively small, while the pump power rises at an ever increasing rate. Below a certain velocity the reduction of pump power is negligible, while the decrease in the rate of condensation is very marked. There is, therefore, for every case, a certain velocity which will give most the economical results.

The limits within which this best velocity lies and the method by which it may be ascertained for any case are discussed by R. M. Neilson in *The Engineer* for September 9. In Mr. Neilson's opinion, the velocity should not be finally decided upon until the internal diameter of the condenser tubes and the quantity of water to be passed through the tubes per minutes have been determined. Previous articles in *The Engineer* have discussed the problems of tube diameter and quantity of water; to a review of the latter we devoted considerable space in our September issue. We now give in abstract Mr. Neilson's examination of the problem of velocity, with reproductions of a number of the more important of his illustrative diagrams.

Let t_i and t_o be, respectively, the inlet and outlet temperatures of the circulating water in degrees F.; t_v, the temperature of saturated steam corresponding to the vacuum; δ, the difference between t_v and t_o; K, the amount of steam, in pounds, which can be condensed per square foot of cooling surface per hour per degree F. difference in temperature between steam and water; p, the absolute pressure in the condenser in pounds per square inch; Q, the weight of water circulating per hour in pounds; H, the head required to drive the water through the condenser in feet; and v, the velocity of the water in feet per second.

It is known that the condensation rate is influenced by the velocity of the circulating water to a great extent at certain velocities and to a less extent at higher velocities, but the precise nature of the relation between K and v cannot be said to be settled. There is reason, however, to believe that K is influenced by variation of v in a manner which can be expressed by the equation

$$K=\frac{C_1}{C_2+\frac{C_3}{C_4+v}}$$

where C_1, C_2, C_3 and C_4 depend on the vacuum within the condenser, the amount of air, the cleanness and diameter of the condenser tubes, and the general design of the condenser. There can thus be an infinite number of curves connecting K with v. Three curves shown by Mr. Neilson illustrate the fact that as v increases, dK/dv is a diminishing quantity; or in other words, the rate of increase of K with increase of v diminishes as v rises in value.

The frictional head which has to be overcome in pumping the circulating water through a condenser varies—approximately at least—as the square of the water velocity. It is further affected by the velocity in an indirect manner. For a constant hourly flow of circulating water and a constant internal tube diameter, the number of tube elements must vary inversely as the velocity. As the tube elements are reduced in number—to suit increased water velocity—they must be increased in length to give the requisite cooling surface. This increase in length may necessitate an increase in the number of water passes to avoid an excessive tube length, and both these increases augment the frictional head in a manner indirectly dependent on the velocity.

Mr. Neilson demonstrates mathematically that H varies as a power of v, whose index is variable but always greater than two. An inspection of curves connecting H and v and K and v shows that at high velocities the head increases at a very rapid rate, while K increases but slowly. At low velocities, on the other hand, change of velocity produces but little effect on the head, while it has a very material effect on K. These curves alone are sufficient to prove that extremes of velocity are undesirable. The determination of the best velocity requires a consideration of the cost of the condenser cooling surface, the effect of variation in the frictional head on the cost of the pump and driving motor, and the cost of energy to drive the pump. If the plant is to be employed nearly continuously, the cost of energy is obviously of more importance relatively to the initial cost of the plant than if the plant is run only a small fraction of the total number of hours in the year. The whole problem is of somewhat the same nature as that dealt with in Mr. Neilson's previous article on the determination of the best value for δ, which was reviewed in our September issue.

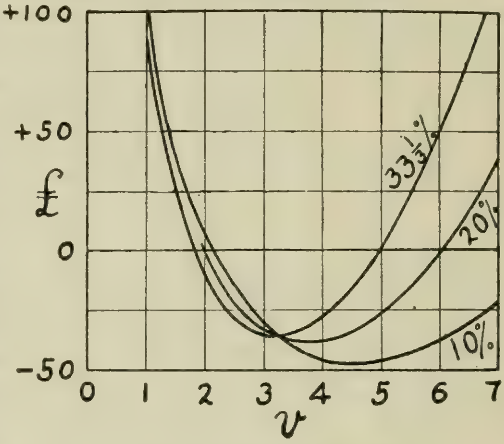


FIG. I. NO EXTERNAL HEAD. $\delta = 20$.

Figures 1, 2 and 3 show the best velocity to employ when the head to be overcome is only the frictional head within the condenser; a total absence of external head is assumed. In each case the plant is assumed to have a capacity of 56,000 pounds of steam per hour, and to maintain a vacuum equivalent to an absolute pressure of 1.5 pounds per square inch with the inlet temperature of the condensing water 82 degrees F. The annual charge for interest, depreciation, repairs, maintenance, taxes and insurance has been taken at 15 per cent. of the initial cost. The circulating pump is assumed to be of the centrifugal type, driven by an electric motor, and the cost of energy is taken at ¾d. per hydraulic horse power hour. The results would not be greatly affected, however, if the electric motor were replaced by a steam engine, provided the cost of steam were equivalent to ¾d. per hydraulic horse power hour. In all the figures here presented, the ordinates indicate the annual charge, which takes into account the interest, depreciation, maintenance, etc., on the first cost of condenser, pump and motor, and the cost of energy to drive the pump. Instead of the total charge, however, the ordinates show only the difference between the charge under the particular conditions and the charge under standard conditions. These standard conditions give to δ a value of 11, to v a value of 3, and to W, p and t_1 the values stated above; in Figures 1, 2 and 3 the external head is assumed to be zero, and in Figures 4, 5 and 6, and also in Figure 2 when this is used in the second series, an external head of 35 feet is assumed.

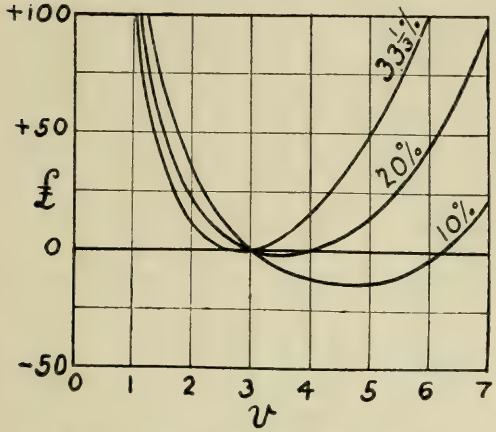


FIG. 2. NO EXTERNAL HEAD. $\delta = 11$.
IN SECOND SERIES EXTERNAL HEAD = 35 FEET.

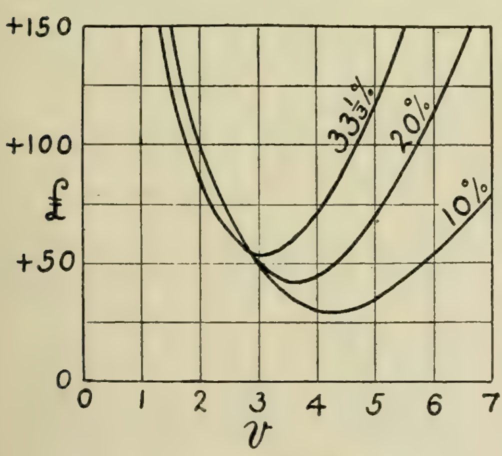


FIG. 3. NO EXTERNAL HEAD. $\delta = 4$.

The values of δ and Q in Figures 1, 2 and 3 are, respectively, 20 and 4,000,000*, 11 and 2,435,000, and 4 and 1,866,667. In each case, plant load factors of 10, 20 and 33 1/3 per cent. have been assumed. It is apparent from Figures 1, 2 and 3 that the best velocity depends to a certain extent on δ, and to a greater extent on the plant load factor, but in no case is it less than 2¾ feet or more than 5 feet per second.

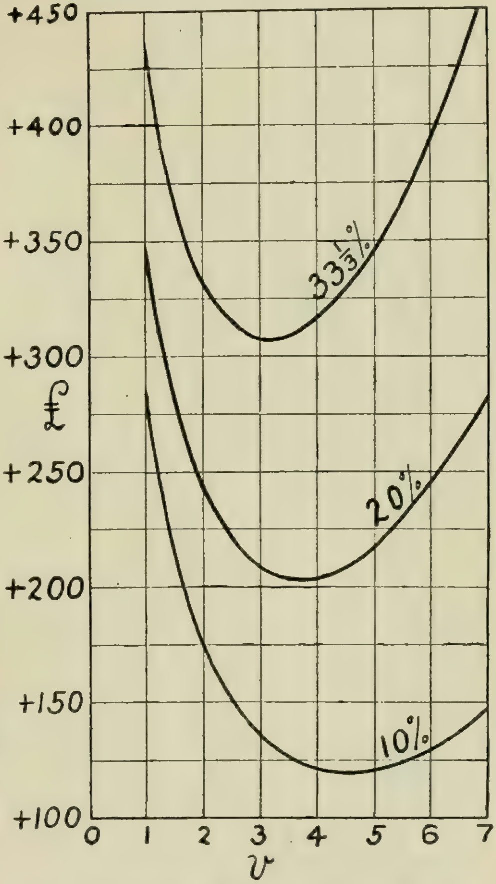


FIG. 4. EXTERNAL HEAD = 35 FEET. $\delta = 20$.

The conditions in the cases represented by Figures 4 and 5 are the same as those in Figures 1 and 3, except that a cooling tower is included which adds an external head of 35 feet to the frictional head within the condenser. Figure 6 is of the same nature as 4 and 5, but with δ equal to zero and Q equal to 1,648,000. As the ordinates in all the figures represent only differences from the values under standard conditions and since these standard conditions are represented in Figure 2, this figure serves whether or not there is a cooling tower and an external head. Figures 4, 2, 5 and 6, therefore, in this order, constitute a series in which δ is progressively decreased and Q progressively increased. The cooling tower and external head make a great difference in the total annual charge, but make no difference in the best velocity to employ in the condenser tubes. It will be seen that in the second series, the best velocity is never below 2¾ feet or above 5 feet per second.

---

* For the method of calculating Q see the review of Mr. Neilson's article in our issue for September,

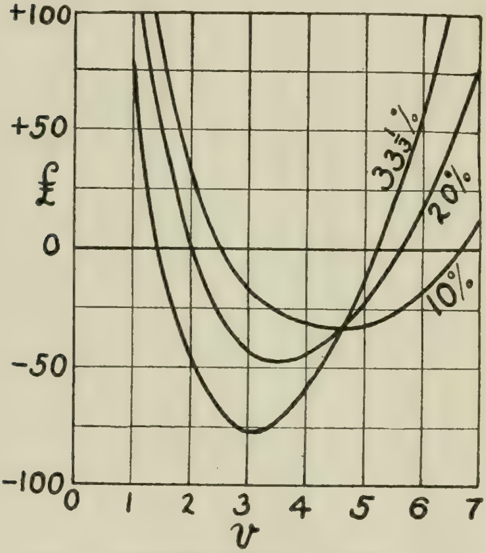


FIG. 5. EXTERNAL HEAD = 35 FEET. δ = 4.

A further series of curves, designed to show the effect of varying charges for energy on the best velocity, is given by Mr. Neilson. These curves are drawn to represent cases in which the cost of energy is, respectively, ½d., 1d., and 1½d. per hydraulic horse power hour, the other conditions being standard. They apply whether there is an external head in addition to the frictional head within the condenser or not. Figure 2, representing a case in which the cost of eneregy is ¾d. per hydraulic horse power hour, forms with these three curves a connected series. With energy at ½d. per unit, the best velocity varies from about 3½ feet per second to 4¾ feet per second. With higher charges for energy, the best velocity varies less; and with a charge of 1½d. per hydraulic horse power hour, the best velocity is never far removed from 3 feet per second within the range of load factors considered.

In all the curves only one vacuum and one inlet temperature of the circulating water have been considered. The curves would be little changed for other vacua if the inlet temperature of the circulating water were increased or reduced by an amount equal to the increase or reduction in the temperature corresponding to the vacuum. Mr. Neilson shows also by means of a diagram that the best velocity in cases where only a moderate vacuum has to be maintained with low temperature of circulating water is still within the limits shown in the diagrams. These limits apply also to the conditions usually met in steamships.

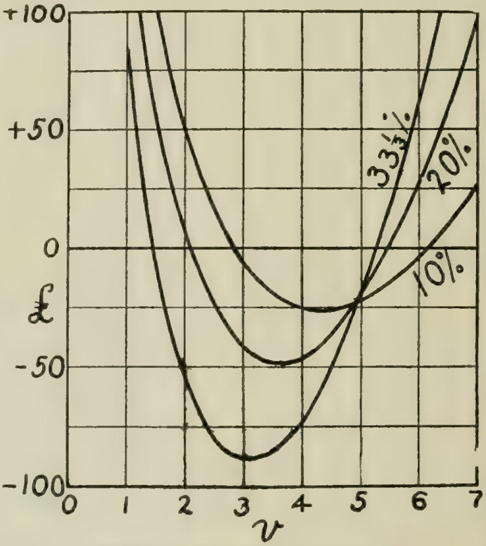


FIG. 6. EXTERNAL HEAD = 35 FEET. δ = 0.

"Much has been done in recent years," Mr. Neilson concludes, "in attempting to reduce the necessary cooling surface in condensers. Sometimes success has been attained by improvements in design without altering the water velocity, the results being in every way good. In other cases the reduction in surface has been wholly or partly attained by increasing the water velocity. Where the velocity was previously unduly low, the change in design has been beneficial; but in many cases, in order to obtain great reduction in surface, the increase in velocity has been pushed too far.

"When it came to be generally recognized that turbines benefited greatly by a high vacuum, there was a tendency to push the vacuum too far till the increase in the cost of obtaining the vacuum was greater than the increase in the benefit derived from it. So with condensers and water velocity; in many cases the velocity has been made too great, till the cost of the increase in the velocity is greater than the benefits derived from the increase. The question, in fact, has not received the consideration which it deserves."

THE STEAM TURBINE IN GERMANY.

A DISCUSSION OF THE GROWING TENDENCY TO MERGE THE DIFFERENT SYSTEMS INTO ONE STANDARD TYPE.

F. E. Junge and E. Heinrich—Power.

BOTH in America and in Europe the most important of recent developments in steam-turbine design seem to be in the direction of the evolution of a general standard type embodying the best features of all existing systems. The merging of systems has progressed less rapidly in America than it has in Europe, but the tendency towards standardization is already well marked. Thus, for some of the Westinghouse turbines, the American representatives of the Parsons type, the double-runner velocity stage of the Curtis system has been adopted for the initial expansion, while it is reported that the General Electric Company, the builders of the Curtis turbine, have built some units in which the Parsons system is used for the final stages.

The progress of standardization in Germany, where it is perhaps most apparent, is described by F. E. Junge and E. Heinrich in *Power* for November 8. "It is an acknowledged fact that the development of steam-turbine construction, after having acquired a high degree of thermal excellence, tends now toward a standardization of the different systems, which at present are dominated and characterized by a few simple principles of steam flow and structure. The following discussion of these principles will be confined merely to axial turbines, because the radial turbine has not so far shown an equal capability of development, at least for purposes of large-scale power production.

"First. The many-stage reaction principle developed by C. A. Parsons. As regards the utilization of steam energy this system is characterized by the fact that the conversion of the potential energy of the steam into kinetic energy takes place not only in the guide-blade channels, but also in those of the rotating part. Regarding construction, the Parsons system is characterized by the use of a drum with dummy pistons and labyrinth packing.

"Second. The many-stage action principle with one row of blades on each rotating wheel, developed by Rateau and modified by Zoelly. As regards the utilization of steam energy this system is characterized by the fact that the conversion of the potential steam energy into kinetic energy takes place in the guiding apparatus only, while the whole kinetic energy of a stage is utilized in a single row of rotating blades. Regarding construction, the Rateau-Zoelly system is characterized by the employment of several disk wheels and by the separation of the different stages through guide-wheel disks, which reach unto the hubs of the rotating wheels.

"Third. The many-stage action principle with velocity staging developed by Curtis. As regards the utilization of steam energy, this system is characterized by the fact that the whole potential energy of one stage is, as a rule, transposed into kinetic energy in expanding nozzles, and further, that the kinetic energy of each stage is utilized in several rows of revolving blades. Regarding construction, the Curtis system possesses rotating disk wheels, like No. 2, but fewer in number, which are equipped with several rows of blades; in addition, it possesses deviating blades which are fixed in the casing.

"The principle of one-stage action has not been included in the above. This system, as developed by De Laval, shows in its practical execution several remarkable solutions; for instance, the flexible shaft and the disk wheel with high peripheral velocity. But the very nature of the De Laval turbine, at least in its original form, militates against the attainment of high capacities. The high peripheral velocity and the resulting high number of revolutions necessitate the employment of gears in order to get down to practicable speeds. Gears for high output have not, however, found favor in stationary practice. In the Riedler-Stumpf turbine the attempt was made to attain reasonable speeds by adopting very large wheel diameters and best material. But practice has evinced that buckets milled into the rim of the wheel would not stand the eroding action of the steam jet, and that the steam consumption increased very materially owing to the destruction of the sharp admission edges of the buckets.

"The three above-mentioned fundamental principles of steam-turbine construction have developed each for itself in Germany. Gradually, however, there has been a fusion of the different systems. For example, the A. E. G. has abandoned the Curtis construction of the low-pressure part of its 1,500 revolutions per minute type and has adopted the principle of many-stage action as developed by Rateau and Zoelly. Up to this year the pure Curtis principle was followed in its 3,000 revolutions per minute type, showing two pressure stages with two velocity stages each. The best known type of this class is the turbine of 1,000-kilowatt capacity. But for outputs beyond 1,000 kilowatts the A. E. G. now builds the low-pressure part after the Rateau-Zoelly principle. Evidently the cost of construction of the said type of 3,000 revolutions per minute, which contains only two rotating wheels with two rows of buckets each and only one guide-wheel disk, is lower than the cost of a turbine of equal output which contains, besides a rotating wheel with two rows of buckets, from five to seven wheels with one row of buckets and the same number of guide-wheel disks. But the severe demand for a low steam-consumption guarantee, which would enable the firm successfully to compete with other German makes, forced the designer to adopt a somewhat more expensive construction. The Bergmann Electric Works build their turbine similarly, using a combination of the Curtis and Rateau principles.

"Even the foremost of the German firms representing the Parsons interests, Brown, Boveri & Co., have, after long hesitation, resolved to follow the example of other builders of reaction turbines. They have replaced the high-pressure stages of the Parsons turbine by a Curtis wheel, reducing the length and weight of the unit enormously. Only for large units and special-service conditions is the pure Parsons principle maintained. Last, but not least, the Curtis principle begins to intrude into the Zoelly syndicate, which, so far, has resisted with tenacity all attempts to change its original mode of construction. The Augsburg Nürnberg Works, members of the syndicate, have just begun to build all of their 3,000 revolutions per minute types on a combination principle, using the Curtis and Zoelly features. The Görlitz Machine Works, licensees of Zoelly, have also built normal types of turbines in accordance with the above principle, but only for sizes below 700 kilowatts. The other members and licensees of the Zoelly syndicate have not adopted the new practice.

"Summing up it may be said that turbine construction tends toward the creation of a standard system of unity, which will include all of the best features of the different types. In the present stage of development the following variations exist: First, the combined Curtis and Rateau system; second, the combined Curtis and Parsons system; third, the pure Rateau-Zoelly system; fourth, the pure Parsons system; fifth, the pure Curtis system. The above order of importance has been arranged according to the influence which, in our notion, the various systems exercise upon the art of turbine building for stationary purposes in Germany to-day.

THE PHILOSOPHY OF PROCESS INVENTIONS.

A CRITICISM OF THE ATTITUDE OF THE COURTS OF THE UNITED STATES ON THE PATENTABILITY OF PROCESS INVENTIONS.

E. D. Sewall—Machinery.

THE laws of the United States provide for the grant of a patent to any one who has invented a new and useful art, machine, manufacture, or composition of matter. No doubt ever arises as to the patentability of new and useful machines, manufactures and compositions of matter; these are concrete things, cognizable by both the senses and the intellect. With respect to art or process inventions, however, the most fundamental doubts in the law of patents arise. Judicial interpellation indicates that process inventions whose results can be apprehended only through the intellect are not patentable, while those that produce a change in the condition of matter that is perceptible to the senses may be patentable. Even when process inventions clearly relate to the useful arts within the provision of the constitution, the greatest uncertainty has prevailed throughout the history of patent law, not only in the United States but in European countries also.

The status of process inventions is examined by E. D. Sewall in an interesting article contributed to *Machinery* for September. In the brief abstract of this paper following, we are obliged to confine our review to Mr. Sewall's summary of the philosophy of process inventions, omitting his illustrative citations of court decisions in the United States and England. "The phrases 'mechanical process' and 'function of the machine,'" says Mr. Sewall, "have been disastrous to many a valuable invention. It has been enough to say that a process is merely 'manipulative,' involving 'no chemical or other elemental action,' to deny its patentability.

"The prejudices against mechanical or manuipulative processes have about the same kind of vague foundations as popular superstitions. . . . . . Three classes of inventions corresponding exactly with the intellectual laws of invention have always been expressly recognized in the United States statutes. These three classes are (1) the product or thing produced—represented by the words 'manufacture' and 'composition of matter,' (2) the way or method of producing the product, or of accomplishing an industrial effect (when the product of the process is not a concrete thing, as a form of energy), represented by the word 'art,' (3) the instrument used to aid in practicing the 'art,' represented by the word 'machine.'

"The order of inventive conception is (1) the product, (2) the process of making the product, (3) the machine for carrying out the process. In answer to the question, 'What shall I make?' the inventor conceives the product; to the question, 'How shall I make it?' he conceives the process; to the question, 'By what means shall I practice the process?' he conceives the machine. He must have a clear notion of a product before he can devise a process of making it and must perceive clearly the process before he can build a machine to practice that process. Patents rank in value in the same order. The patent for a manufacture gives the broadest possible protection, since subject to it are all possible processes of making it. The next broadest protection is afforded by the process patent, since subject to it are all possible machines whose *modus operandi* is the process. The protection afforded by the apparatus or machine is the most limited of all. Of course a machine or apparatus may be the product desired, and the process of making that machine will then be inferior in patent value to the machine. Or the ultimate result may be an effect, not resulting in a manufacture, produced by a process carried out by the aid of a product which in turn becomes an instrument inferior in value to the process. But always, in the relation of value and rank, the process is higher than the instrument used in practicing it, and the product is higher than the process by which it is made.

"Higher still than any of the three kinds of inventions—product, process, and apapratus—stand effect, result, principle, which are not inventions. In accordance with natural law and with the fundamental principles governing monopolies, principle, result, effect, cannot be monopolized. They are the property of all equally, and become known by perception, not by invention. There can be no lawful claim for an effect or principle. A claim in a patent or application for patent for an invention in any one of the three statutory classes conclusively concedes pre-knowledge of that which stands higher in rank. A claim for a product concedes pre-knowledge of the mode of using it and of the effect or results designed to be produced by its use; a claim for a process conclusively concedes pre-knowledge of the principles utilized in the process, of the product made by that process; and of all instruments the use of which is made a part of the process; a claim for an apparatus concedes previous knowledge of the process it is designed to practice.

"The principles just stated are fundamental and essential to be applied in testing any alleged invention. It must also be remembered that all invention lies in the mental conception. For obvious reasons the invention is not a patentable one until it has been made potentially available to the public. But in testing any claim for the presence or absence of invention, the inventive conception must be resorted to and the rank of that conception determined. . . . . .

"No valid product patent can be so broad in scope as to prevent the possible allowance of other non-infringing product patents designed to secure the same effect. No valid process patent can be so broad as to hold as an infringement every other possible process patent for producing the same product. No valid machine patent can be of such scope as to close the field to other machines for carrying out the same process. By 'possible' is here meant theoretically possible, as it may occur, as in the telephone invention, that the method discovered and applied is the only one. This is a fundamental truth of patent law, notwithstanding that the existing mass of patents granted fail to support it.

"Process inventions are in general the most fundamental ones. They *are* the 'useful arts.' The most valuable manufactures have been known and used for years; and as ways of manufacturing essentially old products are the prime problems of manufacturing industries, it is most important to have process inventions protected.

"A process is a way of attaining a result; and any process that is new, useful, and based on an inventive conception, is patentable under the law, if it is applied to 'science and the useful arts.' It matters not whether or not it includes 'chemical' reaction or 'similar elemental action,' or is carried out by an automatic machine. The only conditions precedent imposed by the law are that it shall be new, useful, and an invention; and those conditions apply equally to all classes of invention.

"The much discussed and much applied phrases 'function of a machine,' 'mere mechanical process,' should be dropped from consideration in determining the patentability of a process. They have no bearing on the question of invention involved. Process inventions should be approached in the same way as machine or article inventions.

"In settling whether a defined process is patentable it must, of course, be determined that it is within the field of permissible monopolies, and if it is, then it must be ascertained, (1) if it is new, (2) if it is useful, (3) if it is an invention—nothing else. The question of utility presents little difficulty and that of novelty, none, except research into the existing art. The serious question is that of invention. In settling this, most of the negative rules applicable to machine inventions are applicable to processes, and there is no more mystery connected with the treatment of process than with the treatment of machine inventions. If the process alleged is an 'aggregation' of separate processes, if it involves over an old process the mere substitution of an equivalent step, it is not patentable.

"The word 'mystery' was frequently applied to processes in the early days of patent monopolies. The word aptly indicates the essential quality of a patentable process. To be patentable a process must be mysterious to one who has not been informed. No process that is not mysterious, that does not include hidden steps, no process that is apparent when the result of it, or the principle involved in its practice, is considered, is patentable.

"Chemical processes have been uniformly admitted patentable. What are the 'similar elemental actions' that render process inventions patentable? Can anyone conceive of any acts performed on matter, gaseous, liquid, or solid, that do not take advantage of some elemental law of nature? One hammers iron into a nail, taking advantage of the laws of cohesion and malleability. One sifts ashes aided by the law of gravity, one folds paper, taking advantage of the property of flexibility. But whether elemental action is involved or not is wholly immaterial; such action probably always is involved. The sole thing to be considered is whether there is a 'mystery' which this process has unraveled.

"Every machine and every instrument operates to practice some process in whole or in part. The fact that that process is ancient and common makes it none the less a process. The process of smoothing wood by planing, or shaping iron by hammering, is still a process under the patent laws, although an ancient one. A process that is carried out by an automatic machine may be no less an invention than one carried out by hand or by chemical reagents. . . . . .

"The question is always one of invention. Some things cannot be done by hand. Gases cannot be confined without instrumentalities, and metals cannot be shaped by the fingers. Instruments are usually necessary to the practice of processes. A claim for a process practiced by a particular instrument as a rule does not define the real invention; but it is conceivable that the use of a particular instrumentality for practicing a process may be of the essence of the invention, or that a new process may be devised for operating an old machine. Denial of validity of process inventions by allegations that they are the mere functions of a machine would better give place to treatment by considering the novelty and utility in the abstract process or series of steps as a mental conception divested from any instrumentalities, and then, presuming the abstract process to be disclaimed, considering whether there was any invention in selecting the stated instruments to aid in practicing it."

BAROMETRIC PRESSURE AND LIBERATION OF FIREDAMP.

A THEORY OF THE RELATION BETWEEN LIBERATION OF FIREDAMP IN COAL MINES AND BAROMETRIC PRESSURE, BASED ON EXPERIMENTS AT LIÉVIN, FRANCE.

Léon Morin—Annales des Mines.

MINING engineers are not yet agreed on the theory of gas liberation in coal mines which attributes to barometric pressure an important influence on the rapidity with which firedamp escapes into the atmosphere. There is no lack of evidence, however, of the fundamental validity of the theory. Galloway, who investigated the question for the British Royal Commission on Accidents in Mines, noted the importance of observing barometric changes, and on his recommendation a rule covering this point was inserted in the Mines Regulation Act. In Germany, the experiments of Schondorff and Nasse in 1875 and 1877 established the danger to be apprehended during periods of low pressure, especially in mines comprising large areas of old workings. While the French Commission of 1880 questioned the influence of atmospheric pressure, Le Chatelier agreed that worked-out areas would be more susceptible than new workings. Five years later the theory was firmly established by Koehler's well known researches at the Karwin mines in Westralia, and additional confirmation was given by Chesneau in 1886. In later years the theory has been widely accepted as an explanation of the cause of mine explosions, F. Laur, for example, in 1907, attributing the disasters at Reden, Liévin, Charleston and Fayetteville to the period of depression preceding each explosion.

The latest investigation of the question, and perhaps the most scientific ever made, is that of Léon Morin, whose report, originally published in *Annales des Mines,* is abstracted in the *Engineering and Mining Journal* for September 17. M. Morin's experiments, which extended over a period of two months, were made at four upcast shafts at Liévin, France, each of which had a large tributary area of worked-out ground. At one of these, Shaft No. 13 of the Du Souiche du Levant mine, the percentage of gas was determined every hour, except on Sundays, and at the other three, every eight hours. The Du Souiche shaft was used only as a upcast air shaft, and it was found that the volume of air circulating in the mines was almost perfectly uniform. The area circumscribed by the air current was 166,000 square metres. Except for a small working 12 metres below, the seams above and below the Du Souiche were untouched coal.

Every precaution was taken to secure accuracy in taking the hourly samples. At the beginning of the experiment, simultaneous samples were taken near the roof, near the middle, and at the floor, but it was found that the three samples were identical in composition, owing no doubt to the mixing of the air by the high velocity of the air current. The analyses were made by means of Coquillion apparatus as modified by Le Chatelier, which were frequently calibrated and checked by the use of the Le Breton device. Here too every possible precaution to secure accuracy was observed. Barometric observations were made at the surface only, a method proved by Koehler to be permissible, by means of a recording aneroid, which was compared daily with a mercury barometer.

An inspection of the curves plotted from the data recorded during the experiments warrants the following conclusions: "(1) even slight variations in atmospheric pressure induce variations in the escape of firedamp; other things being equal, while atmospheric pressure remains constant, the liberation of firedamp is equally uniform; (2) when atmospheric pressure increases, the escape of gas diminishes, and conversely; (3) maximum atmospheric pressure corresponds with minimum percentage of gas, and *vice versa;* (4) the variations in percentage of gas may reach great importance; thus, a fall of from 770 to 740 millimetres in the barometer increases the proportion of methane by 50 per cent.; and (5) there is no exception to the general rule of inverse ratio between variation in pressure and variation in percentage of gas.

"The first explanation of the phenomena that occurs to one is that the empty spaces in the old working places of the mine constitute a kind of reservoir for the firedamp, absorbing it when the atmospheric pressure is high, and liberating it again when the pressure falls. It is obvious that the old workings of a coal mine do contain numerous voids, in crevices, in rooms incompletely gobbed, and in the gob itself. If the settling of the surface followed closely after the exhaustion of the coal, the percentage of voids in the old workings would be smaller, but this settling is not complete, usually, depending upon the nature and thickness of the strata, the supporting power of the waste filling, the timbering, and other factors. The closure of the voids is never perfect, even after the surface has settled as much as it will."

This theory M. Morin has found to be untenable. Experiments made to determine the character of the air contained in old workings showed that it was impossible to secure from old workings samples of air rich in gas, even when the sampling pipes were located close to the roof and at one of the highest places of the mine. The tests indicated that while the exhalations from old workings, no matter how carefully packed, may contribute gas to the ventilating current of adjacent operations, they do so to only an unimportant degree. Old workings are, therefore, not the only, nor even the most important, cause of variation in the percentage of firedamp liberated by a given coal mine. A sufficient explanation for the phenomena must be sought in the original source of the gas.

The principal sources of firedamp in coal mines are the unbroken coal at the breasts of working places, freshly broken coal, and the rock strata adjacent to the coal seam. M. Morin has investigated the relative importance of these sources of contamination. In the case of massive, unbroken coal, the results indicate that the permeability of massive coal, in a seam so situated as to drain itself of gas, increases slowly at first, and then much more rapidly as soon as the drainage becomes well established. From freshly broken coal, results were obtained showing a richness in gas exceeding the explosive proportion; it is apparent, therefore, that coal thrown into the gob, as well as the carbonaceous rocks in floor and roof, continue to evolve gas after the working face has passed on. As to the gas exhaled from rocky strata, M. Morin's tests showed that the floor and the roof of a coal seam contain gas which they gradually relinquish after the period of active work has passed. At a distance from the seam, however, the percentage of gas in the barren rocks becomes very minute, except as it may be transmitted there through fissures leading from other sources.

Turning now to the effect of barometric pressure on the liberation of gas from these original sources, M. Morin has been unable to discover that the volume of gas exhaled by the solid coal in working faces shows any variation corresponding to fluctuations in barometric pressure. As for coal and carbonaceous rock in the mine filling, the gas which they contain is probably dissipated in a comparatively short time, and does not greatly affect the subsequent fluctuations in the percentage of gas observed in the ventilating current. M. Morin believes, therefore, that barometric changes affect mainly the quantity of gas liberated by the floor and roof of the seam under operation, whether this gas is contained in the rocks themselves or comes through fissures from adjacent seams.

"The gaseous zone above and below the seam under development," he says, "retreats as work in the seam advances; as the coal is removed the roof settles and the floor tends to rise, causing fractures through which the gas of adjoining virgin seams enters the workings. A solid seam is comparatively impervious to the passage of gas. The pressure that actuates a flow of gas through the fractured zone is, therefore, entirely independent of the original pressure existing in the neighboring seams in their undisturbed condition. The barometric variations, always of relatively small magnitude, are not, then, pitted against the pressure of kilograms, as it exists in solid seams, and are, therefore, able to influence the flow of gas from this fissured zone to the degree which we have observed.

"As the drainage of gas from the fractured region becomes more complete, the pressure becomes more and more feeble, thus permitting the barometric variations to exert a more and more pronounced influence upon the outflow. Thus, in addition to the normal flow of gas under high pressure from the working face and from the newly formed fissures close to the working face, we can readily imagine an outpouring of gas through floor and roof, copious though under low pressure, the volume of which will be proportional to the area of the old workings of the mine. This, I believe, is the source of gas, most susceptible to barometric changes, that is responsible for the tremendous observed variations in the quantity of firedamp liberated by a given coal mine.

"On this supposition, it is easy to interpret the results of our experiments in the Du Souiche seam. The quantity of liberated gas does not depend alone on the magnitude of the fluctuation in pressure, but also on the absolute barometric reading at each moment, becoming thereby proportional to the length of time elapsed between the two extreme pressures defining the fluctuation. On this ground, also, we can explain the disproportionate values found by computing the volume of voids in the old workings; neither are we compelled to assume that these voids are filled with pure methane, an assumption not borne out by our observations. . . . . .

"As a means of discounting the effect of fluctuations in pressure upon the outflow of gas in a mine, it has generally been suggested that the ventilating fan should be driven faster during periods of low pressure, but it is equally important that the speed should be reduced whenever the pressure is high. This is a delicate means of adjustment, especially if some form of electric motor, the speed of which is so easily regulated, be used to drive the fan. It should be remarked, however, that any attempt to attain complete uniformity of gas percentage in the air from a whole mine would require abnormal and impracticable regulation of the motor speed, but any mechanical device helping to increase the supply of air during periods of low barometric pressure should be considered a distinct step in advance.

"In this connection it may be of interest to outline the use that may be made of hooded ventilators for utilizing the power of the winds produced by the very barometric changes that we are trying to circumvent. These hoods can be supplied to both downcast and upcast shaft, assisting the power of the mechanical ventilator by the amount of their combined effort. From data as to wind velocities, air densities, and other factors, collected in the vicinity of our mines, we have computed that a wind having a velocity greater by 10 metres per second than that of the current down the air shaft produces a motive force equivalent to 27 millimetres of water. Our normal fan pressure during the summer is 45 millimetres of water, for the exhaustion of 77 cubic metres per second, which, in winter, becomes 25 millimetres, with an output of 102 cubic metres. I strongly recommend the use of these hoods, wherever feasible, as an adjunct to mechanical ventilators."

A MODIFICATION OF THE CYANIDE PROCESS.

A BRIEF SUMMARY OF THE CLAIMS OF THE CLANCY PROCESS, WHICH EMPLOYS CALCIUM CYANAMIDE AND ELECTROLYSIS.

Metallurgical and Chemical Engineering.

THE modified cyanide process suggested by John C. Clancy is one of the most interesting, and, if the claims of the inventor are substantiated in practice, one of the most important, of recent metallurgical inventions. The point of most interest is that Mr. Clancy proposes to substitute calcium cyanamide, which is now very cheaply produced electrically by the fixation of atmospheric nitrogen by means of calcium carbide, for part or all of the sodium cyanide or potassium cyanide now used. If this substitution can be made, it will mean a considerable saving in the cost of recovering the precious metals. The process is complicated by the necessity of employing electrolytic action, but the electrolytic apparatus is so simple in construction that its maintenance is not likely to add substantially to the operating costs.

In the November issue of *Metallurgical and Chemical Engineering* is printed a long extract from a foreign patent specification written by Mr. Clancy, which describes the process in detail and gives a large number of examples of the method of treating ores of different compositions. The following paragraphs summarize Mr. Clancy's claims and give a brief outline of the chemistry of the new process. "I have discovered," says the inventor, "that a cyanogen-bearing compound which is not a solvent of the precious metals can be made a solvent of the same by the addition of an amidine or amide compound in the presence of an electric current. As a result of this discovery I am able to use cyanogen compounds, heretofore not available in the cyanide process, and also I am able to regenerate spent cyanide solutions, and I am also able to use in the cyanide process oxidizing agents without loss of available cyanide.

"I have also discovered that when the pulverized ore is converted into a pulp by mixing the said ore with a substantially non-acid solution of a thiocyanate containing a halogen salt, and electrolyzing this mixture, then the precious metals only will be dissolved to the substantial exclusion of the baser metals, and that the above solution may be used with advantage in conjunction with the ordinary cyanide solution, and that this process may be successfully applied to either rebellious or non-rebellious ore without preliminary roasting, even though such ores contain reducing agents or tellurium or both.

"In the practice of my invention I may use the crude cyanamide of commerce, its isomerides and polymerides, as a solvent for the precious metals and other metals contained in ores; or I may use a soluble cyanamide in conjunction with the cyanide process in the treatment of ores, and as a means of regenerating cyanide solution or non-available cyanogen-bearing solution.

"When a soluble amidine or amide compound (such, for example, as dicyandiamidine, urea, guanidine, guanidylgluanidine, guanidine carbonate, formamide, oxamide, cyanamide, dicyanamide, or the various polymeric and isomeric modifications of the last-mentioned compounds) is added to a cyanogen-bearing solution and the mixture electrolyzed in contact with ore, the consumption of cyanide is very strikingly reduced; and also solutions containing cyanates, before, after or during the treatment of ore (together with ferrocyanides, ferricyanides, thiocyanates, or other such non-available cyanogen compounds formed in the treatment of ores) may be converted into compounds which readily dissolve the precious metals contained in ores; and most remarkable is the regeneration of cyanide from cyanates, such as alkaline cyanates, isocyanates and the various isomeric and polymeric compounds, or the oxygen derivatives of cyanogen, their isomerides and polymerides.

"I have described the addition of a soluble amidine or amide compound, which may also include any of the above-mentioned compounds; but I use preferably, when working my process, a soluble cyanamide (such, for example, as calcium cyanamide, as it is at present the cheapest source of an amidine or amide compound). A solution of calcium cyanamide, or its isomerides and polymerides, when subjected to electrolysis, is, I have discovered, capable of dissolving the precious metals, and other metals, without any other admixture of cyanogen-bearing material. From cyanamide all the amide or amidogen compounds I have mentioned are very easily prepared. . . . . . .

"To show the action of these amide compounds I may take, for example, urea (carbamide) and add this to a solution of a cyanate (such, for example, as potassium cyanate) and electrolyze this mixture between inert electrodes. After a few minutes the said mixture will be transformed into one which will dissolve the precious metal in alkaline solution. It is well known that cyanates have absolutely no dissolving effect upon the precious metals, and that the formation of cyanates in the cyanide solution represents the chief source of loss of cyanide in the cyanide process, since when cyanates are allowed to stand for any considerable time, or are retained in solution, they are converted into ammonia and potassium carbonates and are transposed by the lime used in the cyanide process into insoluble carbonates, or by the action of sulphuric acid in the ore into sulphates, so that the original cyanide finds itself eventually in the residue dumps in the form of calcium sulphates or insoluble carbonates. Any oxidation means, when used in the cyanide solution to hasten the dissolution of the precious metals, increases the cyanide consumption, due to the formation of cyanate, which is often very great; and up to the present no means for regeneration or recovery of cyanide from cyanate in aqueous solutions has ever been discovered, so far as I am aware; but by my discovery that a soluble amidine or amide compound (such, for example, as calcium cyanamide) added to the cyanide-bearing solution, in conjunction with the electrolysis of said solution, opens up a cheap way whereby oxidation means other than atmospheric oxygen (such as treatment of cyanide-bearing solutions with oxidizing agents and soluble halogen compounds, or other oxidation means) may be successfully employed for readily dissolving and extracting precious metals from refractory ores, such as tellurides, arsenides, sulphides and other ores containing reducing agents. In general, this process may be successfully applied to either rebellious or non-rebellious ores without preliminary roasting, even though such ores contain the refractory compounds mentioned.

"The apparatus for carrying my process into effect is simply the ordinary agitating tank furnished with electrodes spaced about from 1½ inches to 2 inches apart. These electrodes may be made of carbon, or one of iron and another of carbon; that is to say, the positive electrode undergoes no deterioration, as only nascent hydrogen is produced at the said electrode; therefore, iron answers the purpose. The negative electrode or anode is made preferably of a hard graphite or other such inert material. The circulation caused by the agitation keeps the whole mixture constantly circulating between the said electrodes. This circulation is maintained for a period of from 8 to 12 hours to obtain the desired results." The consumption of electrical energy, in the examples cited ed by Mr. Clancy, is about 90 to 120 amperes per ton of ore."

THE CONTROL OF MOTORMEN BY CAR METERS.

A REVIEW OF THE RESULTS OBTAINED IN EUROPE BY THE USE OF CAR METERS ON TRAMWAYS.

G. Bouton, M. Battes—Union Internationale de Tramways.

REPLIES received by the Union Internationale de Tramways et de Chemins de Fer d'Intérêt Local in response to a *questionnaire* sent out to the members indicate that the use of car meters as a means of controlling motormen is rapidly increasing in popularity among the managements of European tramways. In 1906 only ten tramways had adopted the use of car meters. By 1908 the number had risen to 26. It was reported at the recent biennial meeting of the Union that 37 tramways have definitely adopted this method of controlling their motormen, twelve are carrying on tests towards this end, while three have finally renounced the use of car meters.

A summary report on the replies to the *questionnaire,* prepared by M. G. Bouton, general manager of the East Paris Tramways, is abstracted in *The Electrician* for October 7. In M. Bouton's opinion, the question which has to be solved to-day is not so much whether it is advantageous or not to control the work of motormen by means of meters, but to choose between the different methods of applying this principle, between the apparatus and the method of using the results which are obtained. The two points of view from which the question can be considered, while apparently diverse, are in reality quite closely connected. The proper solution of the problem differs from undertaking to undertaking, and is affected by many factors. In exceptional cases, facilities for efficient supervision, low power consumption, and cheap power may create conditions in which control by means of meters would be of little use. When the undertaking does not come within this class of exceptional cases, a choice must be made among the various instruments, with a view to securing the utmost possible regularity of readings. There are now three types of car meters, each of which has its advantages and disadvantages; but as these advantages and disadvantages are of different kinds, each system may be best accommodated with one particular type of meter.

"Clock meters, although very simple, do not measure what one is trying to obtain, *i. e.,* the energy consumption of the car. Partisans of clock meters recognise in principle that this reproach is well founded, but they consider that in practice the indications which are obtained are just as good as those obtained from wattmeters in allowing an efficient control over the motormen. They further state that the question is more complex

TABLE I. FIRST AND OPERATING COSTS.

Type of meter	Watt.	Ampere-Hour.	Clock.
First cost:			
Lowest	£3 14s.	£4 5s.	£1 14s.
Highest	£9	£5 12s.	£5 4s.
Average	£5 8s.	£4 16s.	£2
Per car mile	0.007d.	0.006d.	0.003d.
Running expenses per car mile:			
Lowest	0.002d.	0.002d.	0d.
Highest	0.005d.	0.005d.	0.001d.
Average	0.003d.	0.003d.	0.0005d.
Administrative expenses per car mile:			
Lowest	0.004d.	0.004d.	0.0002d.
Highest	0.05d.	0.05d.	0.0009d.
Average	0.01d.	0.01d.	0.0004d.
Total expenses per car mile	0.02d.	0.019d.	0.004d.

than simply determining the energy consumption; that what the manager requires to know is the greater or less skill of each motorman in expending only the minimum of energy possible in producing a certain amount of useful work. This work produced, which appears under the very simple form of a certain service effected, is in reality so complex that it is not possible rigorously to measure it. Allowing that its intrinsic value depends on a certain number of factors, some of which are of an essentially variable nature, such as the efficiency of the gearing, the atmospheric conditions, the number of passengers, the traffic on the routes, and the knowledge of the motorman, they consider that whatever type of meter is employed there must exist the same and rigorous proportion between each of the readings and the skill of each of the motormen whose work is judged by these readings."

With this view M. Bouton is not in sympathy, and in opposition to it he quotes results of tests on various lines which show a complete lack of concord between the records furnished by clock meters and by ampere-hour meters or wattmeters. "The results of these tests further indicate that with the clock meter the skill of the motorman is measured by means of a unit—the time the car is under current—whose value, compared with the quantity of energy consumed, is susceptible of very great variation according to the way the car is operated. In consequence, the readings of the clock meter are not sufficient by themselves to determine the skill of the motorman. These indications can only be of real use when very close control causes the motorman to work in a uniform manner according to the rules which have been laid down. This is only realized with difficulty, especially on lines in traffic, or else under the condition which is very seldom fulfilled of possessing a *personnel* which is sufficiently conscientious to follow the instructions which are given, without any inspector being necessary."

Of the other two types of meter in use, the wattmeter and the ampere-hour meter, "the first is most complete, as it makes a true comparison, in which each motorman in each car possesses a certain rank in accordance with the energy consumption. It is more complex, however, and more costly than the second, which consists simply of the classification on the 'dossier' of each motorman, and on the way bills, of the readings given by the meters, and the average time during which a car is under current for the service it has undertaken. The first allows a proper classification of the motormen to be obtained, while the second simply points out those who are working in a reprehensible manner."

Data of first and operating costs of the different types of meters are summarized in the table following. In each case the life of the instrument is assumed to be 187,500 car miles.

"In a general way it is recommended that the work of motormen as regards energy consumption should be controlled by means of meters. This control is only truly efficient when each car is fitted with a meter. The application of the control can be effected in two ways: In the first, with a view to ensuring that the individual motorman consumes the lowest amount of energy compatible with the necessities of the service, an influence is exerted on the *personnel* by dis-

TABLE 2. SAVINGS EFFECTED BY THE USE OF CAR METERS.

Place.	Type of Meter.	Number of Meters Installed.	First Cost per Meter.	Economy of Energy, per cent.	Annual Saving.
Amsterdam	Clock.[a]	235	£2 4s.	11.5	......
Berlin	"	1,491	£2 [b]	7.8	£21,344
Berne	"	41	......	10 [c]	......
Cologne	"	410	£2 1s.[d]	8.6	£45,000
Düsseldorf	"	All cars.	£1 15s.[b]	5 to 7	......
Barmen-Elberfeld	" [e]	"	£2	......	......
Hagen	" [e]	"	£2 6s.	6	......
Gladbach	"	....	£3 2s.	4.3	......
Neuenburg	" [e]	....	£2 16s.	11.3	......
Nuremburg-Fürth	"	....	....	6.2	£ 650
Dresden	Watt.	504	£3 15s.	.....	......
Mulhausen	"	19	......	10	......
Stockholm	"	All cars.	£6 17s.	5.75	£ 1,925
Bordeaux	Amp.-hour.	"	£4 5s.[f]	10	£ 1,600
Marseilles	"	10	......	.....	......
"	Clock.	15	......	.....	......
East Paris	Amp.-hour.	287	£5 13s.[g]	7.27	£ 2,419

---

[a] Installed after comparative tests of clock and wattmeters. The cost of repairs is practically nil; the administration expenses are about 0.0026d. per car mile. [b] The administration expenses are 0.004d. per car mile. [c] On 10 cars. [d] Repairs costs are 0.0004d., and administrative expenses 0.01d., per car mile. [e] Replacing wattmeters which cost £7 10s. each. [f] The repair costs per annum are 12s. 6d. per car, and the administration expenses 0.009d. per car mile. [g] The maintenance cost is 0.005d., and the administrative expenses 0.009d., per car mile.

tributing among the most skillful pecuniary prizes whose value is proportionate to the results obtained, while at the same time disciplinary measures are taken against those whose work leaves something to be desired. This method requires the periodical classification of the *personnel* by determining, as exactly as possible, the relation between the energy consumed by each motorman to the standard eneergy consumption for the work done. This method also predicates, as a logical conclusion, the employment of either a watt or ampere-hour meter.

"In the second way an attempt is made to get the different motormen to do their work in as uniform manner as possible. They are no longer classed according to the energy they consume, but by the way they differ from a standard line of operation. In this case a clock meter may be employed, the results which it gives being sufficient, always allowing that its work is supplemented by personal supervision, which must increase as the *personnel* becomes less conscientious.

"If a system is operated by a *personnel* who are favourable to the idea of rewards, while the system itself is of such a nature that supervision of the motormen is difficult, while the amount of traffic leads to frequent stoppages, the gradient profile is irregular, the cars are heavy, the motors closely designed, the price of energy is high, etc., all conditions tending to increase the influence of the motormen on the operating expenses, the solution given first above is to be recommended. If the conditions under which the system operates are quite the reverse of these, the second solution is preferable."

M. Bouton's conclusions as to the inefficiency of clock meters are not supported by M. Battes, who also submitted a report on the replies to the *questionnaire* at the same meeting of the Union Internationale. M. Battes gives data of the savings effected by the use of car meters, which are summarized in Table 2. "From these results," he says, "it appears that important systems cannot do without some sort of control over the energy consumed, while this control may be practically realized by means of some relatively simple apparatus. The different systems of control, whether by wattmeters, ampere-hour meters or clock meters, have given quite favorable results. The majority of the companies who have answered the questions use clock meters, and these instruments have indubitably furnished results quite as good as either wattmeters or ampere-hour meters. Besides, taking into account the importance of the financial results obtainable, the first cost and costs of upkeep, which are much higher for the last two types than for clock meters, can certainly be neglected, and each system may, therefore, be allowed the choice of determining what sort of instrument it should use."

THE ENGINEERING INDEX

"THE KEYSTONE IN THE ARCH OF APPLIED SCIENCE"

The following pages form a *descriptive* index to the leading and special articles of permanent value published currently in the Transactions of all the important engineering societies of both Europe and America, and in all the leading engineering journals of the world—in the English, French, German, Dutch, Italian, and Spanish languages.

The term *descriptive* is used because the definite purpose of each index note is to indicate clearly the character and purpose of the article or paper described; and with that in view we give the following essential information about every publication:

(1) The title of the article,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published,
(7) *We supply the article itself, if desired.*

☞ The full text of every article described in the Index, together with all its illustrations, can usually be supplied by us.—See the "Explanatory Note" at the end of the Index, where also the full titles of the principal journals indexed are given.

NOTE—The busy engineer will also observe that the Index is conveniently classified into the larger divisions of engineering science, to the end that the reader may quickly turn to what concerns himself and his special branches of work. By this means it is possible, within a few minutes' time each month, to learn promptly of every important article published anywhere in the world, in any language, upon the subjects claiming one's special interest.

DIVISIONS OF THE ENGINEERING INDEX.

CIVIL ENGINEERING	Page 451	MECHANICAL ENGINEERING	Page 465
ELECTRICAL ENGINEERING	" 458	MINING AND METALLURGY	" 475
INDUSTRIAL ECONOMY	" 463	RAILWAY ENGINEERING	" 482
MARINE AND NAVAL ENGINEERING	" 464	STREET AND ELECTRIC RAILWAYS	" 485

CIVIL ENGINEERING.

BRIDGES.

Causeways.

The Galveston Causeway. Illustrated detailed description of a two-mile railway and highway structure between Galveston Island and the main land, now under construction. 3000 w. Eng Rec—Oct. 15, 1910. No. 17862.

Culverts.

Laying and Repairing Cast Iron Pipe Culverts in Soft Ground. Information from replies to letters of inquiry sent out by a committee of the Am. Ry. Bridge & Building Assn. 2700 w. Eng Rec—Oct. 22, 1910. No. 18116.

Drawbridges.

Erection and Elevation of a Double-Track Drawbridge Under Traffic. W. L. Six. Illustrated description of work in connection with track elevation work at Milwaukee, in which novel methods were employed in erecting a drawbridge across the Kinnickinnic River. 3000 w. Eng News—Oct. 6, 1910. No. 17718.

See also same title, under ELECTRICAL ENGINEERING, POWER APPLICATIONS.

Foundations.

Foundations of the Rüstringer Bridge at Wilhelmshaven (Fundierung der Rustringer Brücke bei Wilhelmshaven). Herr Röhlke. Describes the construction of foundations for a swing bridge over the Ems-Jade canal. Ills. 4500 w. Beton u Eisen—Sept. 2, 1910. No. 18071 F.

Masonry.

Stone Highway Bridges. J. H. Everest. Gives the stress diagram, with its application to design of masonry bridges. Supplement. 3500 w. Surveyor—Oct. 7, 1910. No. 17901 A.

Piers.

The St. Louis Municipal Bridge Substructure. Illustrated description of methods used in constructing the piers of this double-deck, double-track railway and highway structure. 2200 w. Eng Rec—Oct. 15, 1910. No. 17863.

Quebec.

The North Caisson of the Quebec Bridge. Illustrates and describes details of design and construction. 1200 w. Eng Rec—Oct. 1, 1910. No. 17592.

Building and Sinking the Quebec Bridge North Caisson. Illustrated detailed description of this feature of the work, and of the temporary house protecting the caisson during construction. 1800 w. Eng Rec—Oct. 15, 1910. No. 17869.

Reconstruction.

The Reconstruction of the Old West Viaduct at the Amsterdam Central Station (De Dichting van de oude Westelijke Viaduct op het Centraalstation te Amsterdam). J. W. Nierstrasz. Illustrated description of the work and of the new structure. 5800 w. De Ingenieur—Sept. 17, 1910. No. 18211 D.

Reinforced Concrete.

A Short Description of the Existing Bridges at Waterford and Portumna, and of the Proposed New Structures to Replace them. Ills. Discussion. 8000 w. Trans Inst of Civ Engrs of Ireland—Vol. XXXVI. 1910. No. 18223 N.

The Erection of a Reinforced-Concrete Bridge in Two Sections (Herstellung einer Eisenbetonbrücke in zwei Bauabschnitten). Hermann Roch. Describes the design and construction of a highway bridge of the girder type. Ills. 3000 w. Beton u Eisen—Sept. 24, 1910. No. 18075 F.

Steel.

An Eight-Track Overhead City Bridge. Elevation, erection and brief description of an 8-track bridge with ballasted floor across Broadway in Buffalo, N. Y. 900 w. Eng Rec—Oct. 1, 1910. No. 17590.

Viaducts.

The Providence Station Viaduct. Illustrated detailed description of structural features of interest. 1700 w. Eng Rec—Oct. 22, 1910. No. 18123.

The Penhorn Creek Viaduct of the Erie Railroad. Illustrated detailed description of this new viaduct near Jersey City, N. J. 5000 w. Eng News—Oct. 13, 1910. No. 17838.

Reinforcement of the Pecos River Viaduct. Illustrates and describes reinforcement to meet requirements of the present practice of heavy engine loading of this viaduct on the So. Pacific in Texas. 1500 w. Ry Age Gaz—Oct. 14, 1910. No. 17854.

The Strengthening of the Pecos River Viaduct. Illustrates and describes work, made necessary by the heavy engine loading of present practice, on this viaduct in Texas. 1200 w. Eng Rec—Oct. 29, 1910. No. 18245.

The Sitter Viaduct on the Bodensee-Toggenburg Railway (Der Sitterviadukt der Bodensee-Toggenburgbahn). A. Acatos. Detailed description of the construction of a high masonry-arch structure with one long steel-truss span. Ills. Serial. 1st part. 2000 w. Schweiz Bau—Sept. 10, 1910. No. 18056 B.

See also Reconstruction, under BRIDGES.

CONSTRUCTION.

Beams.

See Columns, under CONSTRUCTION.

Boring.

Methods of Conducting Test Borings and of Sinking Shafts for the Hudson River Crossing of the Catskill Aqueduct. A description of the work, with diagrams. 5000 w. Engng-Con—Oct. 26, 1910. No. 18189.

Coal Pockets.

Two Reinforced Concrete Coal Pockets. Myron S. Falk. Describes two pockets built during the past year. One in Brooklyn, the other in New York City. Ills. 1500 w. Pro Am Soc of Civ Engrs—Oct., 1910. No. 18216 F.

Columns.

Bending Moments in Concrete Wall Columns and Fixed Beams. Gives mathematical investigations and conclusions in connection with the sheet-metal shop of E. Van Noorden, in Boston. 2500 w. Eng Rec—Oct. 15, 1910. No. 17865.

Tests of Centrally and Eccentrally Loaded Brick and Concrete Columns (Versuche mit zentrisch und mit exzentrisch belasteten Pfeilern aus Backsteinmauerwerk und aus Beton). C. Bach. Describes the tests and gives detailed results. Ills. 6000 w. Zeitschr d Ver Deutscher Ing—Sept 24, 1910. No. 18203 D.

Concrete Mixers.

New Devices for Preparing and Mixing Concrete (Neuere Maschinen zur Betonbereitung und Verarbeitung). Describes exhibits at the Second Exhibition of the clay, cement, and lime industries at Berlin. Ills. Serial. 1st part. 1000 w. Deutsche Bau—Sept. 24, 1910. No. 18054 B.

Mortar and Concrete Mixers at the Second Exposition at Berlin (Le Mescolatrici da Malta e Calcestruzzo alla II Esposizione di Berlino). Describes the exhibits. Ills. 2500 w. Il Cemento—Sept. 30, 1910. No. 18029 D.

Contractors' Plants.

The Construction Plant for the Holter Dam. Illustrated description of the arrangement of the contractor's camp and of the general methods of construction at a hydroelectric development in Montana. 3500 w. Eng Rec—Oct. 29, 1910. No. 18243.

See also Reservoirs, under WATER SUPPLY.

Cost-Keeping.

Organization and Cost-Keeping on the Los Angeles Aqueduct. Explains the scheme for keeping records of the progress and cost of this great engineering work. 2500 w. Eng Rec—Oct. 15, 1910. No. 17867.

Excavation.

Earth Excavation (Die Bodengewinnung bei grossen Erdarbeiten). H. Contag. Discusses the cost of excavation by hand labor and machine, with a review of German practice. Ills. Serial. 1st part. 7200 w. Zeitschr d Ver Deutscher Ing—Sept. 3, 1910. No. 18096 D.

Fireproof.

Fireproof Building Construction. E. T. Cairns. A discussion of fire waste and the factors that cause it, construction, design, materials, etc. 6000 w. Stevens Ind—Oct., 1910. No. 17728 D.

Modern Practice in Factory Construction from a Fire Protection Standpoint. William D. Grier. Discusses the layout and construction of manufacturing plants and their care and management to prevent fire or explosion. 4500 w. Stevens Ind—Oct., 1910. No. 17730 D.

See also Mine Buildings, under MINING AND METALLURGY, MINING.

Floors.

The Türk Hollow Reinforced-Concrete Floor (Eisenbeton-Hohldecke von Türk, Mannheim). A. Marx. A description of this type of hollow concrete floor with some data of cost. Ills. 3000 w. Beton u Eisen—Sept. 2, 1910. No. 18073 F.

Foundations.

Erection of the Substructure of the Pennsylvania Terminal Post Office. Illustrated description of unusual work at the Penn. terminal, New York City, in erecting a post-office building over the depressed tracks in the yard. 2200 w. Eng Rec —Oct. 1, 1910. No. 17595.

Unusual Foundations for a Twelve-Story Building. Foundation work in West 26th St., New York City, is illustrated and described—30 steel columns carried on clusters of 3 to 6 steel and concrete piles driven to bearing on solid rock at depths of 30 to 40 ft. below curb. 2500 w. Eng Rec—Oct. 8, 1910. No. 17769.

Hoppers.

The Deformations of a Four-Sided Hopper. Clyde T. Morris. An experimental study of the stresses in such structures and the most efficient position of the stiffeners. Ills. 1500 w. Eng News—Oct. 6, 1910. No. 17721.

Hydraulic Filling.

A Hydraulic Fill in the Turlock Irrigation District Canal. A. Kempkey, Jr. Illustrated detailed description of the replacing of the "Peaslee Gulch" flume with a permanent structure. 1500 w. Eng Rec —Oct. 29, 1910. No. 18246.

Pipe Tunnels.

Pipe Subways in European Cities. Information from a recent report by Nelson P. Lewis. 4000 w. Eng News—Oct. 27, 1910. No. 18198.

Reclamation.

The Drainage of Northeastern Arkansas. Arthur E. Morgan. Describes the area considered, including about 1,000,000 acres, and the proposed plan of improvement. 3500 w. Mfrs' Rec—Oct. 6, 1910. Serial. 1st part. No. 17700.

See also Irrigation, under WATER SUPPLY.

Reinforced Concrete.

Steel Wire Concrete Reinforcement. Illustrates and describes the use of woven fabric in various forms of construction. 1400 w. Ir Trd Rev—Oct. 27, 1910. No. 18227.

Rapid Formulae for the Calculation of Reinforced-Concrete Beams (Formules rapides pour le Calcul des Poutres en Béton armé). M. Rougié. Derives simple approximate formulae. Ills. 3000 w. Rev Indus—Sept. 17, 1910. No. 18015 D.

See also Columns, and Stadium, under CONSTRUCTION.

Retaining Walls.

The Cracking and Partial Failure of Abutments and Retaining Walls. Charles K. Mohler. Charges bad design and poor economy in past and present practice of wall construction, giving examples. Ills. 3000 w. Eng News—Oct. 13, 1910. No. 17839.

Wing Walls in Reinforced Concrete (Flügelmauern aus Eisenbeton). E. Elwitz. Works out a numerical example of the design of a wall of this type. Ills. 3500 w. Beton u Eisen—Sept. 24, 1910. No. 18074 F.

The Determination of Retaining-Wall Sections (Ueber die Querschnittsbestimmung von Staumauern). Mathematical discussion of the stresses in retaining walls of various sections. Ills. 3000 w. Oest Wochenschr f d Oeffent Baudienst—Sept. 3, 1910. No. 18068 D.

Sheet-Metal.

Sheet-Metal Construction of Pier Sheds. Illustrated explanation of methods employed in handling corrugated iron, skylights, and ornamental iron. 3500 w. Met-Work—Oct. 29, 1909. No. 18238.

Stables.

Structural Improvements in a Large Stable. Improvements in Stable A, of the New York Department of Street Cleaning, are illustrated and described. 2000 w. Eng Rec—Oct. 8, 1910. No. 17773.

Stadium.

The Tacoma High School Stadium. Leslie D. Howell. States the conditions affecting the plans, and illustrates and describes the structure in reinforced-concrete which has a seating capacity of 30,000. 2500 w. Eng Rec—Oct. 29, 1910. No. 18247.

Tunnels.

The Otira Tunnel, New Zealand. Brief illustrated description of a tunnel under construction through the Southern Alps. 500 w. Engr, Lond—Oct. 7, 1910. No. 17914 A.

Tunneling on Los Angeles Aqueduct. R. L. Herrick. Map and illustrated description of conditions found and methods used. 6500 w. Mines & Min—Oct., 1910. No. 17613 C.

Excavation of Walkill Pressure Tunnel, Catskill Aqueduct (New York City Water Supply). C. Raymond Hulsart. Map and illustrated description of the pressure tunnel type of construction, and details of the work. 4500 w. Eng News—Oct. 20, 1910. No. 17955.

Underpinning.

Deep Underpinning Through Sand. Illustrated explanation of main wall needles supported on cribbing as used in work at 26th St. and 5th Ave., New York City. 1500 w. Eng Rec—Oct. 22, 1910. No. 18117.

MATERIALS OF CONSTRUCTION.

Bituminous Materials.

The Properties of Asphalt and Bituminous Materials (Contributo sperimentale alla Cognoscenza dei Bitumi sulle Proprieta fisico-tecniche degli Asfalti e dei Bitumi). G. Maderna. Discusses methods of testing, etc. Ills. Serial. 1st part. 4500 w. Il Cemento—Sept. 30, 1910. No. 18028 D.

Concrete.

The Behavior of Hydraulic Compounds in Sea Water. H. Burchartz. Gives results of strength units and observations of concrete blocks. 3000 w. Engr, Lond —Oct. 14, 1910. No. 18167 A.

The Influence of the Electric Current on Concrete (Versuche über den Einfluss des elektrischen Stromes auf Beton). W. Gehler. Reviews briefly Knudson's results and reports a more recent series of tests made in Germany. Ills. Serial. 1st part. 4000 w. Beton u Eisen—Sept. 2, 1910. No. 18072 F.

Paints.

The Preparation of Magnetic Oxides of Iron from Aqueous Solutions. Siegfried Hilpert. Read before the Iron & Steel Inst. Gives experiments and results in proof of disagreement of conclusions reached in a paper by Mr. Carulla, as to the chemical and mechanical reactions involved. 1200 w. Ir & Coal Trds Rev—Sept. 30, 1910. No. 17814 A.

Reinforced Concrete.

Bond-Friction-Resistance in Reinforced Concrete. William Fry Scott. An investigation of the reinforced-concrete beam, giving the various steps leading to the final results. Ills. 7500 w. Pro Am Soc of Civ Engrs—Oct., 1910. No. 18215 F.

MEASUREMENT.

Surveying Instruments.

The Mathematical Instrument Office of the Survey of India. Illustrated description of the instruments of precision used, and an outline of the work carried on by one of the largest concerns of its kind in the world. 1800 w. Engr, Lond—Sept. 30, 1910. Serial. 1st part. No. 17832 A.

MUNICIPAL.

City Planning.

The Art of Laying Out Cities. F. Bottge. An illustrated account of recent progress on the Continent. 2000 w. Cassier's Mag—Oct., 1910. No. 17695 B.

Tramways in Relation to Town Planning. A. Baker. Paper and discussion before the Munic. Tram. Assn. Considers the damage done in developing suburban areas, the advantage of tramway traffic and the administration of the town planning act. Ills. 12500 w. Tram & Ry Wld—Oct. 6, 1910. No. 18151 B.

Industrial Wastes.

Present Status of the Disposal of Sulphite Liquor in Germany. Dr. A. Pritzkow. Abstract translation. A review of the work of the Royal Testing Institute, giving an outline of the present status of this problem. 3000 w. Eng Rec—Oct. 22, 1910. No. 18121.

Pavements.

Wooden Block Pavement Tests in Minneapolis, Minn. D. M. Avery. An illustrated report of the results obtained with five kinds of wood. 1500 w. Munic Engng —Oct., 1910. No. 17983 C.

The Concrete and Macadam Streets of Richmond, Ind. Information concerning these pavements and their cost. 1500 w. Munic Engng—Oct., 1910. No. 17984 C.

Street Paving in New Orleans. Martin Behrman. Read before the League of Am. Municipalities. Information concerning the kinds of pavement, cost, etc. 1800 w. Munic Engng—Oct., 1910. No. 17982 C.

The Victoria Embankment Pavement. Information from the report issued by the

Engng. Dept. of the London County Council in Jan., 1910, in regard to the extensive paving experiments on this thoroughfare carrying a very heavy traffic. 1400 w. Eng Rec—Oct. 22, 1910. No. 18115.

Refuse Disposal.

The Practical Questions Concerned in the Collection and Disposal of Municipal Waste. William F. Morse. Considers the engineering problems involved in the past and present methods and apparatus in use in America for the treatment and disposal of municipal waste. General discussion. Ills. 12500 w. Jour Assn of Engng Socs—Sept., 1910. No. 17999 C.

Roads.

The Economics of Modern Highway Engineering. Arthur H. Blanchard. Read before the Am. Soc. for Munic. Imp. Considers the construction of roads and streets subject to modern traffic. 2000 w. Eng Rec—Oct. 22, 1910. No. 18119.

Modern Surface Treatments of Roads. Charles W. Ross. Read before the Nat. Good Roads Con. A critical discussion of modern methods, with report of results from various treatments. 2500 w. Eng Rec—Oct. 15, 1910. No. 17864.

Protective Coatings for Roads in Massachusetts. Austin B. Fletcher. Read at the Brussels Int. Cong. Considers the change in traffic conditions and the effect on roads, reporting resurfacing and other road work during 1908 and 1909. 2800 w. Eng Rec—Oct. 1, 1910. No. 17596.

Dustless Roads of California. Austin B. Fletcher. Read before the Nat. Good Roads Convention. Conditions in So. California are discussed, and the efforts to lessen the dust nuisance. 3500 w. Eng Rec—Oct. 8, 1910. No. 17776.

Dustless Roads in Europe. Arthur H. Blanchard. Read before the Nat. Good Roads Con. Discusses unique features of European practice which deserves the careful consideration of American engineers. 5000 w. Eng Rec—Oct. 1, 1910. No. 17598.

Road Drainage. From the last report of W. A. McLean, Ontario, Canada. Especially considers conditions in Canada, showing drainage to be the essential principle in road construction. 2200 w. Engng-Con—Oct. 26, 1910. No. 18190.

The Development of Panama by Public Roads. Edward Perry. An illustrated account of the government policy in road construction and improvement. 2000 w. Engineering Magazine—Nov., 1910. No. 18256 B.

Continuous and Systematic Road Maintenance. S. Percy Hooker. Read before the Nat. Good Roads Assn. Directions for the care of improved roads and the cost. 2500 w. Eng Rec—Oct. 8, 1910. No. 17768.

Cost of Rural Road Building in Peel County, Ontario. C. R. Wheelock. Information from a recent report of work done on different classes of roads, with costs. 2000 w. Can Engr—Oct. 6, 1910. No. 17783.

Septic Tanks.

The Present Utility of the Septic Tank. H. N. Ogden. Read before the Am. Soc. of Munic. Imp. Explains what the septic tank accomplishes and its limitations. 1700 w. Engng-Con—Oct. 19, 1910. No. 17949.

Sewage Disposal.

Economy in Sewage Disposal. C. Chambers Smith. Read before the Roy. San. Inst. Deals with conditions in England, suggesting ways by which economy may be advanced. Discussion. 3000 w. Surveyor—Sept. 23, 1910. No. 17666 A.

First-Hand Impressions of German Sewage Disposal. H. N. Ogden. General remarks, with information concerning methods and their application to conditions in the United States. Also editorial on "The Need for a More Rational View of Sewage Disposal," and a letter from Palmer C. Ricketts on stream pollution. 8600 w. Eng News—Oct. 13, 1910. No. 17840.

Diffusion and Digestion of Sewage in New York Harbor. Discussion from the report of the Metropolitan Sewerage Commission, based on extensive studies. 18000 w. Engng Con—Oct. 26, 1910. No. 18192.

Sewage Disposal Works, Alliance, Ohio. E. G. Bradbury. Explains conditions and describes a new plant providing for sedimentation and double filtration, to prevent the pollution of a river used for water supply. 2500 w. Eng Rec—Oct. 15, 1910. No. 17866.

Sewage Disposal System of Toronto. C. H. Rust. Read before the Am. Soc. of Munic. Imp. Illustrated description of the treatment previous to the discharge into Lake Ontario. 2500 w. Munic Jour & Engr—Oct. 26, 1910. No. 18183.

A Novel House and Street Sewerage System for Portions of Manila, P. I. George H. Guerdrum. Describes a system for the drainage of the sanitary barrios now being built. Ills. 900 w. Eng News—Oct. 6, 1910. No. 17717.

Sewage Pumping.

See Pumping Plants, under MECHANICAL ENGINEERING, Hydraulic Machinery.

Sewers.

The Maximum Flow of Storm Water in Sewers. P. H. M'Carthy. Discusses methods of determining the necessary allowance for storm water in sewers. Tables and discussion. 6 plates. 8400 w. Trans Inst of Civ Engrs of Ireland—Vol. XXXVI., 1910. No. 18222 N.

Reinforced Concrete Sewers in Soft Ground, Seattle. Illustrates and describes the sewers being constructed through the reclaimed area, explaining the conditions. 1500 w. Eng Rec—Oct. 22, 1910. No. 18120.

Condition of Manhattan Sewers. An illustrated summary of conditions found during a recent inspection. 1800 w. Munic Jour & Engr—Oct. 5, 1910. No. 17702.

WATER SUPPLY.

Aqueducts.

See Cost Keeping, under Construction; and Siphons, under Water Supply.

Catskill.

See Boring, under Construction; and Reservoirs and Siphons, under Water Supply.

Dams.

The Design of Reservoir Dams, with Some Accounts of Failures. F. C. Uren. Discusses the considerations influencing the design, the causes affecting stability and related subjects. Describes failures in earth and masonry dams. Discussion. 5 plates. 23500 w. Trans Inst of Civ Engrs of Ireland—Vol XXXVI., 1910. No. 18218 N.

The Design and Construction of the St. Andrews Movable Dam and Lock on the Red River at Lockport, Manitoba. Edwin A. Forward. Illustrated detailed description. 4500 w. Eng News—Oct. 6, 1910. No. 17716.

An Arched Dam at Las Vegas, New Mexico. Explains details of the design and reasons for adopting particular features. 1500 w. Eng Rec—Oct. 8, 1910. No. 17770.

Arched Masonry Dam at Las Vegas, N. M. Charles W. Sherman. Gives reasons for the construction of this dam and the adoption of the type and of details, describing local conditions affecting the problem. Ills. 3000 w. Eng News—Oct. 27, 1910. No. 18197.

Progress of the Great Barren Jack Dam in Australia. Gives details of a structure of Cyclopean convents, which will be one of the largest of its kind in the world. 2200 w. Engr, Lond—Sept. 23, 1910. No. 17681 A.

Storage Curves (Staukurve). Leo Bloudek. An addition to the author's paper on this subject in this journal for Jan. 22, 1910. Ills. 2000 w. Oest Wochenschr f d Oeffent Baudienst—Sept. 17, 1910. No. 18070 D.

See also Locks, under Waterways and Harbors.

Derwent Valley.

Derwent Valley Water Scheme. Map, showing the scheme for supplying the towns of Leicester, Derby, Sheffield and Nottingham, in England, with illustrated description of the work. Plate. 2000 w. Engr, Lond—Oct. 14, 1910. No. 18168 A.

Filtration.

Filtration Works and Reservoirs for Portsmouth Water Supply. Illustrated description of new works and information concerning them. 3500 w. Engr, Lond—Oct. 7, 1910. No. 17912 A.

Portsmouth Water Works. Illustrates and describes the new filter-beds and covered service reservoirs recently put into commission. 2500 w. Plates. Engng—Oct. 7, 1910. No. 17909 A.

The Mechanical Filter Plant at Wilkinsburg, Pa. Illustrated description of plant for the purification of the water supply. 1500 w. Eng Rec—Oct. 1, 1910. No. 17597.

The Filter Plant at Helsingforz, Finland. E. A. Gieseler. Brief description of conditions and plant, with report of operating results. 1000 w. Eng Rec—Oct. 1, 1910. No. 17593.

Fire Protection.

Automatic Sprinkler Protection. E. P. Boone. Explains the sprinkler system, discussing its proper installation. Ills. 4500 w. Stevens Ind—Oct., 1910. No. 17729 D.

The New Fire-Protection Organization in Milan and the Electric Alarm System (La nuova Organizzazione del Servizio di Estinzione incendi a Milano e l'Impianto di Avvisatori elettrici d'Incendio). Nino Sacerdoti. Ills. Serial. 1st part. 3000 w. Monit Tech—Sept. 10, 1910. No. 18026 D.

Irrigation.

Irrigation Accounting, Its Essentials and Advantages. N. E. Webster, Jr. Condensed paper for the Inst. Irrigation Cong. A study of the phases which are common to all irrigation projects and should be shown in the accounts. 1600 w. Eng News—Oct. 6, 1910. No. 17720.

The Agricultural Side of Irrigation. S. Fortier. On the importance of the agricultural side of the subject, the difficulties, the proper use of water, assistance needed, etc. 2200 w. Eng News—Oct. 27, 1910. No. 18196.

Drainage of Irrigated Lands with Special Reference to Experiments in Utah. Charles F. Brown. Condensation of Farmers' Bulletin, No. 371, U. S. Dept. of Agriculture. Information concerning methods of reclaiming irrigated lands affected by excess of water or alkali, based on work done in Utah. Ills. 6000 w. Eng News—Oct. 13, 1910. No. 17841.

The Las Vegas Irrigation Project, New Mexico. H. H. Barnett. Illustrated description of a collapsible dam and canal system. 2000 w. Eng Rec—Oct. 8, 1910. No. 17766.

Pipe Flow.

See Water, under MECHANICAL ENGINEERING, Measurement.

Pipe Laying.

Labor Cost of Laying 16 Miles of 20-Inch Cast Iron Water Main at Cheyenne, Wyo. M. V. Moulton. Description of the work. 1600 w. Engng-Con—Oct. 26, 1910. No. 18191.

Pipe Strength.

The Collapsing Pressure of Circular Tubes. W. E. Lilly. Develops a rational formula for the collapsing strength of circular tubes under external fluid pressure, showing where the theory, as usually interpreted, is defective. Discussion. Plate. 6500 w. Trans Inst of Civ Engrs of Ireland—Vol. XXXVI., 1910. No. 18220 N.

Pipe Tunnels.

See same titles, under CONSTRUCTION.

Pollution.

Pure Water and the Pollution of Waterways. Dr. Hodgetts. Extracts from an address at Ottawa, before the Dom. Pub. Health Conf. A general discussion of pure water supply, pollution of waterways and disposal of sewage. 3000 w. Can Engr—Oct. 27, 1910. No. 18239.

Portland, Ore.

Enlargement of the Water Works of Portland, Ore. Explains conditions and the plans for improving the service. 1500 w. Eng Rec—Oct. 22, 1910. No. 18114.

Purification.

Water Purification Plant at Richmond, Virginia. Describes a plant for the purification of James River water, by selection of water, long time storage, and coagulation with aluminum sulphate and sedimentation. 1800 w. Eng Rec—Oct. 22, 1910. No. 18118.

Reservoirs.

Cobb's Hill Reservoir, Rochester, N. Y. John F. Skinner. Illustrated description of an unusually large concrete-lined reservoir, with double concrete and waterproofing bottom. 2200 w. Munic Jour & Engr—Oct. 19, 1910. No. 17965.

Methods of Construction and Contractor's Plant on the Ashokan Reservoir, New York Water Supply. Map and illustrated description of construction work in this great storage basin for the Catskill supply. 5000 w. Engng Con—Oct. 19, 1910. No. 17948.

See also Filtration, under WATER SUPPLY.

Siphons.

The Hudson River Siphon Crossing of the Catskill Aqueduct. Samuel D. Dodge and William B. Hoke. Read before the Munic. Engrs. of the City of N. Y. (Slightly altered). Describes the vertical and inclined borings and the test shafts to determine the location and depth for the proposed pressure tunnel which will carry the Catskill supply beneath the Hudson. 6000 w. Eng Rec—Oct. 8, 1910. Serial. 1st part. No. 17775.

Tacoma.

The Green River Gravity Water Supply of Tacoma. Stuart Sims. Plan and description of a project for furnishing an additional supply from an upland river. 2500 w. Eng Rec—Oct. 22, 1910. No. 18122.

Water Towers.

Ornamental Standpipe at Syracuse, N. Y. M. B. Palmer. Illustrated detailed description of a masonry shell enclosing a steel tank. 2000 w. Munic Jour & Engr—Oct. 5, 1910. No. 17701.

Concrete Tower Enclosing a Water-Works Tank at Gary, Ind. Illustrated description of a reinforced-concrete water tower, enclosing a steel tower and tank. 1200 w. Eng News—Oct. 20, 1910. No. 17953.

Methods of Constructing a Reinforced Concrete Water Tower Using Steel Forms and Movable Steel Staging. Illustrates and describes methods recently employed at Westerly, R. I. 800 w. Engng-Con—Oct. 5, 1910. No. 17704.

WATERWAYS AND HARBORS.

Austria.

Interior Navigation in Austria (Bericht über den Stand der Wasserstrassenfrage). An abstract of an official report of progress in canal building and river improvement, with an outline of the projects in hand and proposed. Ills. Serial. 1st part. 8000 w. Oest Wochenschr f d Oeffent Baudienst—Sept. 10, 1910. No. 18069 D.

See also same title, under RAILWAY ENGINEERING, MISCELLANY.

Canal Spillways.

Siphon Spillways on the Champlain Canal. Illustrations and description, taken from the *Barge Canal Bulletin*. 1000 w. Eng Rec—Oct. 8, 1910. No. 17767.

Genoa.

The Port of Genoa (Sul "Porto di Genova"). Mattia Giavotto. Discusses particularly its value as a naval base. Ills. 5000 w. Riv Marit—Sept., 1910. No. 18023 D.

Locks.

Locks and Dams of the Panama Canal. Illustrated detailed description of the work at Gatun, and the methods of construction. 4500 w. Engr, Lond—Sept. 30, 1910. Serial. 1st part. No. 17833 A.

Marine Staging.

Self-Propelled Marine Staging. Brief illustrated description of marine locomotive staging used in England for construction of marine works or excavation. 800 w. Eng Rec—Oct. 8, 1910. No. 17772.

Panama Canal.

A Trip Across the Isthmus: Life and Conditions on the Canal Zone. Martin Nixon-Miller. Reviews the history of this scheme, and describes conditions, giving a brief outline of the work. 6000 w. Pro Engrs' Club of Phila. No. 1092—Oct., 1910. No. 18251 D.

See also Locks, under WATERWAYS AND HARBORS.

Piers.

Loughshinny Pier, County Dublin. W. Collen. Gives the history of this small pier for the accommodation of fishermen, explaining the difficulties and describing the work. 2 plates. Discussion. 10000 w. Trans Inst of Civ Engs of Ireland—Vol. XXXVI., 1910. No. 18221 N.

River Regulation.

Stream Regimen and Dam Construction in the Eastern Alps (Flussregime und Talsperrenbau in den Ostalpen). Discussion of M. Singer's paper published in this journal for Dec. 10 and 17, 1909. Ills. 9000 w. Zeitschr d Oest Ing u Arch Ver—Sept. 30, 1910. No. 18067 D.

Water Powers.

Water Powers. Herbert Knox Smith. Address before the National Conservation Congress. Explains the present situation of the hydro-electric industry and the importance and aim of federal jurisdiction. 1300 w. Eng News—Oct. 20, 1910. No. 17954.

ELECTRICAL ENGINEERING.

COMMUNICATION.

Fire Alarms.

The Reconstruction of the New York Fire Alarm Telegraph System. Herbert T. Wade. Describes features of the proposed system. 2000 w. Sci Am—Oct. 8, 1910. No. 17724.

See also Fire Protection, under CIVIL ENGINEERING, WATER SUPPLY.

Radiotelegraphy.

Experiments in Directive Wireless Telegraphy and Other Means for Securing Selectivity. J. O. Mauborgne. Considers results of experiments made with a view of obtaining greater certainty of transmission. 5000 w. Jour U S Art—Sept.-Oct., 1910. No. 17939 D.

Properties of the Most Important Detectors Used in Wireless Telegraphy. K. Bangert. Abbreviated translation from *Phys. Zeit.* Discusses the behavoir of the electrolytic and galena detectors and the various effects, and describes experiments. 2500 w. Elect'n, Lond—Oct. 14, 1910. No. 18154 A.

The Efficiency of Short-Spark Methods of Generating Electrical Oscillations. W. H. Eccles and A. J. Makower. Examines methods used to estimate the efficiency. 1400 w. Elect'n, Lond—Sept. 30, 1910. No. 17822 A.

Radiotelephony.

Experimental Apparatus for Wireless Telephony. Illustrates and describes apparatus constructed by E. F. Huth, of Berlin, aiming to prove the possibilities of wireless telephony for practical application. 1500 w. Elect'n, Lond—Oct. 7, 1910. No. 17896 A.

Telegraphy.

Discussion on "American Telegraph Engineering—Notes on History and Practice," Jefferson, N. H., June 29, 1910. Discussion on paper by William Maver, Jr., and Donald McNicol. 2500 w. Pro Am Inst of Elec Engrs—Oct., 1910. No. 17989 F.

Telephone Rates.

The Regulation of Telephone Rates and Service in Massachusetts. An account of the revision of telephone rates in Boston and vicinity to place them on an equitable basis. With editorial discussion. 8000 w. Eng News—Oct. 20, 1910. No. 17956.

Telephony.

Telephone Service in America. John J. Carty. Address at Paris, France, giving a review of the progress of the art and an analysis of the methods of operation of the manual and antomatic systems. Also editorial. 8800 w. Elec Rev, N Y—Oct. 15, 1910. No. 17874.

DISTRIBUTION.

Condensers.

Some Investigations on a Celluloid Condenser. G. Vallauri. Abstract of paper in the *Pro. Assn. Elettro. Italiana.* Describes the condenser and experiments made with it. 1200 w. Elect'n, Lond—Oct. 14, 1910. No. 18156 A.

Switches.

New Electric Remote-Control Apparatus (Neuere elektrische Fernsteuerungen). W. Wolf. Describes in detail a number of devices and installations. Ills. Serial. 1st part. 1500 w. Elektrotech Rundschau—Sept. 15, 1910. No. 18077 D.

DYNAMOS AND MOTORS.

A. C. Dynamos.

Discussion on "Parallel Operation of Three-Phase Generators with Their Neutrals Interconnected" San Francisco, Cal., May 5, 1910. Discussion of George I. Rhodes' paper. 5000 w. Pro Am Inst of Elec Engrs—Oct., 1910. No. 17988 F.

A. C. Motors.

The Future of the Single-Phase Series Motor (Bemerkungen über die zukünftige Entwicklung der Einphasen-Reihenschlussmotoren). Maurice Milch. Discusses possible improvements and the probable future of this type of motor. Ills. 2500 w. Elek Kraft u Bahnen—Sept. 14, 1910. No. 18082 D.

Armatures.

Dynamo Armature Cores. Cecil P. Poole. Illustrated article showing how armatures are wound and explaining the relation between torque and the elements producing it. 1500 w. Power—Oct. 4, 1910. No. 17652.

Foundations.

Construction of Foundations for Electrical Machinery. Bruce H. Page. Illustrated article giving directions for the work. 1700 w. Elec Wld—Oct. 6, 1910. No. 177[illegible]3.

Induction Motors.

Multi-Speed Squirrel-Cage Induction Motor. R. E. Hellmund. A comparison of the characteristics of the multi-speed induction motor with those of the direct-current series motor. 1500 w. Elec Wld—Oct. 13, 1910. No. 17859.

Calculation of the Magnetizing Current in Induction Motors (Beitrag zur Berechnung des Magnetisierungsstromes in Induktionsmotoren). Theodor Hoock and R. E. Hellmund. A discussion and criticism of the different methods. Ills. 4000 w. Elektrotech u Maschinenbau—Sept. 4, 1910. No. 18089 D.

Leakage Reactance.

Leakage Reactance. J. Rezelman. Deduces a method for estimating the mutual induction between the overhang coils of the different phases of a stator winding. 2000 w. Elect'n, Lond—Oct. 7, 1910. No. 17897 A.

Railway Motors.

Communication and the Interpole Railway Motor. J. L. Davis. An explanation of the advantages of the interpole design and field control, and of the theory of the interpole. Ills. 5000 w. Elec Jour—Oct., 1910. No. 17973.

See also Single Phase, under STREET AND ELECTRIC RAILWAYS.

Speed Regulation.

A New System of Speed Regulation for Single-Phase and Polyphase Induction Motors of Large and Moderate Powers (Un nouveau Système de Regulation de la Vitesse des Moteurs d'Induction à Courants alternatifs mono- et polyphasés de grande et moyenne Puissance). J. Angibaud. A description of the Scherbius system of speed regulation for induction motors. Ills. 3500 w. Soc Belge d'Elecns—Aug., 1910. No. 18002 E.

See also Rolling Mills, under MINING AND METALLURGY, Iron and Steel.

Windings.

The Design of Shunt Field Windings. Frank W. Merrill. Considers the relation between different variables entering into the design, and describes a method shown to be accurate and direct. 3000 w. Elec Wld—Oct. 6, 1910. No. 17712.

Winding Coefficients for Single-Phase Motors. H. Weichsel. Shows the methods for calculating the winding coefficients for different winding distributions. 2000 w. Elec Rev, N Y—Oct. 15, 1910. Serial. 1st part. No. 17873.

Theory and Construction of Polyphase Generator Windings with a Fractional Number of Slots per Pole per Phase (Theorie und Konstruktion der Teillochwicklungen für Mehrphasengeneratoren). M. Seidner. Discusses various cases in which it may be desirable to use a fractional number of slots. Ills. 5000 w. Elektrotech u Maschinenbau—Sept. 18, 1910. No. 18091 D.

ELECTRO-CHEMISTRY.

Cells.

See Standard Cells, under Measurements.

Electric Furnaces.

A Convenient and Inexpensive Furnace for Very High Temperatures. D. F. Calhane. Brief illustrated description of a laboratory electric furnace for high temperature work. 800 w. Met & Chem Engng—Oct., 1910. No. 17762 C.

See also Refractory Materials, under MINING AND METALLURGY, Mining.

Nitrogen.

The Fixation of Atmospheric Nitrogen. Illustrated description of the Pauling process. 1500 w. Sci Am Sup—Oct. 8, 1910. No. 17726.

ELECTRO-PHYSICS.

Hysteresis.

Hysteresis Loops and Lissajous' Figures, and the Energy Wasted in a Hysteresis Loop. Prof. Silvanus P. Thompson. Abstract of a paper read before the Phys. Soc. Shows that any hysteresis loop can be analyzed into a harmonious series of closed curves corresponding to the various terms in the analysis of the current wave. Also editorial. Ills. 4000 w. Elect'n, Lond—Oct. 7, 1910. No. 17894 A.

Magnetic Properties.

The Magnetic Properties of Iron and their Utilization in Modern Electrical Construction (Ueber die magnetischen Eigenschaften von legiertem Eisen und dessen Verwendung in der modernen Elektrotechnik). Sigm. Guggenheim. Discusses the relation of the purity of the iron used and the efficiency of electrical machinery. Ills. 2000 w. Elek Kraft u Bahnen—Sept. 24, 1910. No. 18084 D.

GENERATING STATIONS.

Bus Bars

The Arrangement of Bus Bars (Die Schienenanordnungen der elektrischen Anlagen). J. Teichmüller. Illustrates and discusses a large number of arrangements. Serial. 1st part. 3800 w. Elek Kraft u Bahnen—Sept. 24, 1910. No. 18083 D.

Central Stations

The Decentralized Plant as the Power Plant of the Future. R. D. De Wolf. Abstract of a paper read before the Nat. Elec. Lgt. Assn. Explains how it will be designed and operated to supply heat, as well as power and light. 4500 w. Heat & Vent Mag—Oct., 1910. No. 18128.

Central Stations with Asynchronous Generators (Stations centrales à Génératrices asynchrones). A. R. Garnier. Discusses plants of this type and describes three installations in Germany. Ills. 2000 w. L'Elecn—Sept. 3, 1910. No. 18008 D.

Oil and Gas Fuel Station at Wichita, Kan. Illustrated detailed description of a modern plant especially noteworthy for compactness and economy of operation. 2500 w. Elec Wld—Oct. 20, 1910. No. 17951.

The Carville Generating Station. The development of the station at Carville-on-Tyne is outlined, and the present plant illustrated and described. Plate. 1700 w. Engr, Lond—Sept. 30, 1910. No. 17835 A.

See also Gas Power Plants, under MECHANICAL ENGINEERING, COMBUSTION MOTORS.

Economics.

The Future of the Central Station. Thomas E. Murray. Read before the Assn. of Edison Ill. Co.'s. Reviews the development, showing the applications for the electric current, and considers the future development promising. 4500 w. Cent Sta—Oct., 1910. No. 17786.

Hydro-Electric.

The Capital City Power Plant of the United Missouri River Power Co. Illustrated description of the dam and hydro-electric plant now under construction, the third of the system of this company, to furnish current for Western Montana. 1600 w. Eng News—Oct. 20, 1910. No. 17959.

The Hydro-Electric Plant of the Cobalt Power Company at Hound Chute. A. Vonaesch. Illustrated description of this development on the Montreal River, furnishing current for light, heat and power. 2500 w. Can Engr—Oct. 13, 1910. No. 17876.

A Low-Head Hydroelectric Plant. Arthur H. Ford. Illustrates and describes the engineering and economical features of the electric generating equipment of the University of Iowa. 2500 w. Elec Wld—Oct. 13, 1910. No. 17856.

The Tuilière Hydro-Electric Plant and the Distribution of Electrical Energy in the Southwest of France (L'Usine hydro-électrique de Tuilière et la Distribution de l'Energie électrique dans le Sud-Quest de la France). A. Dumas. Detailed description of the station and distribution system. Ills. 5500 w. Génie Civil—Sept. 10, 1910. No. 18018 D.

The Piedimulera Power Plant (Das Kraftwerk Piedimulera). A Menge. Detailed description of this important Italian plant serving Novara and its neighborhood. Ills. Serial. 1st part. 2000 w. Zeitschr f d Gesamte Turbinenwesen—Sept. 30, 1910. No. 18060 D.

The Sorio Station of the Milan Hydro-Electric System (La Centrale di Sorio dell' Impianto idroelettrico Milani). Brief description of the plant and machinery. Ills. 2500 w. Industria—Sept. 4, 1910. No. 18025 D.

Isolated Plants.

The Cost of Heat, Light and Power. C. M. Ripley. Abstract of address before the "Blue Room Engng Soc. of Greater N. Y." Gives operating cost and a strong argument for the isolated plant over the central station. 4500 w. Power—Oct. 25, 1910. No. 18138.

Plant of the Bigelow Carpet Company. B. S. Walters. Illustrated description of the mechanical equipment of a 1100 k.-w. a. c. plant. 1000 w. Power—Oct. 4, 1910. No. 17647.

Motor Load of Massachusetts Central Stations. Walter Stuart Kelley. A statistical study of motor loads and their peculiarities based on data from a number of stations. 3500 w. Elec Wld—Oct. 6, 1910. No. 17715.

Netherlands.

Statistics of Electricity-Supply Stations in the Netherlands (Statistiek van Centraal-Stations voor Electrische Stroomlevering in Nederland). Gives details of all central stations in the country. De Ingenieur—Sept. 10, 1910. No. 18210 D.

Rates.

A Safe Energy Rate for Small Central Stations. S. W. Borden. Explains a system of rate making recommended for small stations. 1000 w. Elec Wld—Oct. 13, 1910. No. 17860.

Practical Considerations for the Application of New Methods of Measurement to the Sale of Electrical Energy (Considerazioni practiche per l'Applicazione dei nuovi Metodi di Misura industriale per la Tariffìcazione dell' Energia elettrica). Ricardo Arno. A discussion of the rate-making problem in central station economics. Ills. 4500 w. Monit Tech—Sept. 20, 1910. No. 18027 D.

Switchboards.

The Choice of Switchboard Measuring Instruments (Ueber die Wahl der Schalttafelmessinstrumente). Friedrich Blacizek. A practical discussion of the instruments required, the conditions they should fulfil, and the limits of error permissible. Ills. 3000 w. Elektrotech Rundschau—Sept. 1, 1910. No. 18076 D.

Switches.

See Insulating Materials, under MISCELLANY.

Transvaal.

Electric Power in the Transvaal. Comments on the Electric Power Act. 2500 w. Elec Rev, Lond—Oct. 7, 1910. No. 17891 A.

LIGHTING.

Arc Lamps.

Three-Phase Arc Lamp with Four Carbons. Aldo Righi. Abstract trans. from *Pro. Assn. Elettro. Italiana.* Describes the new arrangement of carbons proposed by the writer. 900 w. Elect'n, Lond—Oct. 7, 1910. No. 17893 A.

Arc Lamps for Projection. Henry Phelps Gage. Investigations made at Cornell University and in Schenectady of illuminants for projection purposes are reported, and conclusions stated. 1800 w. Elec Wld—Oct. 13, 1910. No. 17861.

Illumination.

Recent Study of the Firefly. Herbert E. Ives. A study of the efficiency of the illumination, reporting recent investigations. Also editorial note. 2000 w. Elec Wld—Oct. 13, 1910. No. 17858.

Modern Illumination. Newton Harrison. Brief consideration of the various systems and their applications to different requirements. 2500 w. Cent Sta—Oct., 1910. No. 17785.

Practical Illumination. John Darch. Read before the Roy. San. Inst. Cong. Shows that the principles governing the practice of lighting should conform with the hygienic requirements of the eye, giving suggestions for efficient illumination. 3000 w. Elec Engr, Lond—Sept. 23, 1910. No. 17672 A.

Incandescent Lamps.

High-Power Incandescent Fittings. Notes based on practical experience in this class of work. 1500 w. Elec Rev, Lond—Oct. 7, 1910. No. 17892 A.

Some Notes from Makers of Metal Filament Lamps. Gives experiences with various makes of high-efficiency lamps. Ills. 2000 w. Elect'n, Lond—Sept. 23, 1910. No. 17677 A.

Mercury-Vapor Lamps.

Systematic Investigations of the Efficacy of the Ultra-Violet Rays from Quartz-Tube, Mercury-Vapor Lamps (Systematische Untersuchungen über die Wirksamkeit der verschiedenen ultravioletten Strahlen der Quecksilberdampf-Quartzmantel-Bogenlampen). A review of investigations at the physiological laboratory of the Sorbonne of the bactericidal effects of these rays. 3000 w. Elektrotech u Maschinenbau—Aug. 7, 1910. No. 18087 D.

See also Shop Lighting, under MECHANICAL ENGINEERING, MACHINE WORKS AND FOUNDRIES.

Photometry.

The Ulbricht Ball as a Means of Measuring Mean Spherical or Mean Hemispherical Candle Power (Die Ulbrichtsche Kugel zur Bestimmung der mittleren sphärischen bezw, der mittleren hemisphärischen Lichtstarke). Ernst Winkler-Buscher. Describes the construction and use of Ulbricht's photometric device. Ills. 4000 w. Elektrotech u Maschinenbau—Aug. 7, 1910. No. 18085 D.

Street.

A Variable Contrast Testing Device. Preston S. Millar. Illustrated description of a device for measuring the ability to see in the streets at night. 1500 w. Elec Wld—Oct. 20, 1910. No. 17952.

Outdoor Lighting in England. Norton H. Humphreys. Reports the extensive use of gas lighting, and considers the latest improvements. 2500 w. Am Gas Lgt Jour—Oct. 10, 1910. Serial. 1st part. No. 17787.

MEASUREMENT.

Dynamo Testing.

Testing of Alternators, with Results of Tests on a Three-Phase Machine. J. W. Rogers. Describes methods of making various shop tests on single and polyphase alternators. 800 w. Prac Engr—Sept. 30, 1910. Serial. 1st part. No. 17826 A.

Galvanometers.

The Comparison of Galvanometers and a New Type of Flat-Coil Galvanometer. Edwin F. Northrup. Remarks on design, describing a basis for comparing the merits of different galvanometers, and describing a new type, giving a tabulated comparisons of this type with existing instruments. Ills. 5500 w. Jour Fr Inst—Oct., 1910. No. 17935 D.

Magnetic Balance.

Magnetic Balance of MM. P. Curie and C. Cheneveau. C. Cheneveau, with an appendix by A. C. Jolley. Abstract of paper before the Phys. Soc. Shows how the coefficient of specific magnetization can be calculated from measurements with this balance, and describes the apparatus. The appendix reports the results of tests. Ills. 1300 w. Elect'n, Lond—Sept. 30, 1910. No. 17823 A.

Meters.

An Improved Electricity Meter. Describes improvements in wattmeter construction recently patented by Messrs. Siemens Bros. in conjunction with Francis Sydell. Ills. 2200 w. Prac Engr—Oct. 14, 1910. No. 18158 A.

Photographic Recording Meter. L. M. Aspinwall. Illustrated detailed description. 1200 w. Elec Jour—Oct., 1910. No. 17977.

Meter Testing.

Intervals for Testing Watt-Hour Meters. John Gilmartin. Discusses methods and data for determining the desirable test intervals. 1600 w. Elec Wld—Oct. 6, 1910. No. 17714.

Motor Testing.

Measurement of the Cross-Field Tension in Synchronous Single-Pole Machines (Ermittlung der Querfeldspannung bei synchronen Einzelpolmaschinen durch den Versuch). Karl Pichelmayer. Describes an investigation of methods of direct measurement. Ills. 2200 w. Elektrotech u Maschinenbau—Sept. 25, 1910. No 18093 D.

Standard Cells.

Limitations of the Weston Cell as a Standard of Electromotive Force. S. W. J. Smith. Abstract of paper read before the Phys. Soc. Attempts to explain in terms of the theory of solutions the author's recent experiments on the cadmium amalgams of the Weston standard cell. 3000 w. Elect'n, Lond—Oct. 14, 1910. No. 18157 A.

POWER APPLICATIONS.

Agriculture.

Electricity on the Farm. G. Basil Barham. Considers applications made of electricity and their advantages. 1500 w. Elec Rev, Lond—Oct. 14, 1910. No. 18153 A.

Drawbridges.

The Electrical Operation of Drawbridges. S. F. Nichols. Abstract of a paper read before the Assn. of Ry. Elec. Engrs. Explains the application of the series-wound reversing electric motor to the operation of all kinds of drawbridges. 1800 w. Eng News—Oct. 13, 1910. No. 17842.

Welding.

See same Title, under MECHANICAL ENGINEERING, Machine Works and Foundries.

TRANSMISSION.

Cables.

Potential Stresses in Dielectrics. Harold S. Osborne and Harold Pender. A discussion of high voltage insulation and the grading of cables. 7000 w. Pro Am Inst of Elec Engrs—Oct., 1910. No. 17986 F.

Tests on Bitumen Cables. W. A. Tappin. Report of tests made on the bitumen covering of cables treated in a different manner during the process of manufacture. Also methods of laying cable, localizing faults, leakages, etc. 3000 w. Elec Rev, Lond—Oct. 14, 1910. No. 18152 A.

Cable Repairs. Reports some causes of breakdowns and their repair. 1000 w. Elec Rev, Lond—Sept. 23, 1910. No. 17676 A.

Capacity.

Graphic Representations of the Linear Electrostatic Capacity Between Equal Parallel Wires. A. E. Kennelly. A graphical representation of the quantities involved, with explanation. 800 w. Elec Wld—Oct. 27, 1910. No. 18182.

Constant Potential.

A General Solution of the Problem of Ohmic Resistances in Parallel and Constant Electromotive Force (Allgemeine Lösung des Problems der Parallelschaltung Ohmscher Widerstände und konstanter elektromotorischer Kräfte). Josef Kuhn. Mathematical. Ills. 2800 w. Elek Kraft u Bahnen—Aug. 7, 1910. No. 18086 D.

Frequency Transformer.

An Improved Arrangement for Preventing Brush Sparking in Rotary Electric Frequency Transformers Having Commutators. Illustrated description of a device brought out by Messrs. Siemens Bros. 2200 w. Prac Engr—Oct. 7, 1910. No. 17898 A.

Line Construction.

Discussion on "Transmission Line Crossings of Railroad Rights-of-Way." San Francisco, Cal., May 6, 1910. Discusses Allen H. Babcock's paper. 7500 w. Pro Am Inst of Elec Engrs—Oct., 1910. No. 17990 F.

Line Design.

Approximate Formulae for Transmission-Line Calculations (Annäherungsverfahren bei Berechnung von Fernleitungen). J. Bartok. Derives mathematically a number of simplified formulae. Ills. 5000 w. Elektrotech u Maschinenbau—Sept. 25, 1910. No. 18094 D.

See also Sleet Loads, under Transmission.

Rotary Converters.

Converters. A detailed description of the various types in use and their applications. 5000 w. Engr, Lond—Oct. 14, 1910. No. 18170 A.

Sleet-Loads.

A Study of Sleet Loads and Wind Velocities. Frank F. Fowle. Deals with an analysis of the Weather Bureau records at Chicago, Ill., giving briefly the history of the Chicago station for the period covered by the study. 3500 w. Elec Wld—Oct. 27, 1910. No. 18181.

Surges.

Experience on the Road. Leonard Work. Describes a mysterious surging of an arc circuit and the cause. 1000 w. Elec Jour—Oct., 1910. No. 17979.

Transformers.

Alternating-Current Transformers. J. Stottner. Illustrates and describes types, and refers to dangerous influences on transformers. 2500 w. Ir & Coal Trds Rev—Oct. 7, 1910. No. 17918 A.

Condenser Type Terminals. A. B. Reynders. An illustrated discussion of the possibilities of this type of insulation. 3000 w. Elec Jour—Oct., 1910. No. 17974.

Discussion on "Observations of Harmonics in Current and in Voltage Wave Shapes of Transformers," San Francisco, Cal., May 6, 1910. Discussion of John J. Frank's paper. 5000 w. Pro Am Inst of Elec Engrs—Oct., 1910. No. 17987 F.

Voltage Drop in Transformers (Spannungsabfall von Transformatoren). Faye-Hansen. A review and discussion of methods of measurement. Ills. 2000 w. Elektrotech u Maschinenbau—Sept. 11, 1910. No. 18090 D.

Voltage Drop of Transformers Having a Poor Regulation. K. Faye-Hansen. Discusses the testing of transformers for voltage drop, urging the use of Prof. Bragstad's method for this purpose. 1500 w. Elect'n, Lond—Sept. 23, 1910. No. 17678 A.

See also Insulating Materials, under Miscellany.

MISCELLANY.

Electric Clocks.

Féry Electric Clocks (Horloges électriques Féry). L. Reverchon. Describes their principles and illustrates the apparatus. Serial. 1st part. 1000 w. L'Elecn—Sept. 17, 1910. No. 18011 D.

Insulating Materials.

Transformer and Switch Insulating Oil. J. Vincent Hunter. Discusses the characteristics and insulating qualities of such oil. 1500 w. Power—Oct. 18, 1910. No. 17926.

Moisture and Impurities in Transformer Oil. J. Vincent Hunter. Explains how to detect and remove moisture and, incidentally, any minor impurities in insulating oils. 1600 w. Power—Oct. 25, 1910. No. 18139.

Magnetos.

See Shop Practice, under MECHANICAL ENGINEERING, MACHINE WORKS AND FOUNDRIES.

INDUSTRIAL ECONOMY.

Apprenticeship.

New York Central Apprenticeship. Fred. H. Colvin. An explanation of a system combining school and shop instruction. Ills. 3500 w. Am Mach—Vol. 33. No. 42. No. 17945.

Training Mechanics in Germany. F. A. Halsey. An explanation of industrial training as understood in Germany. Apprenticeship, as a training for workmen, is the means employed. 5000 w. Am Mach—Vol. 33. No. 43. No. 18184.

Corporations.

The Organization of Great Corporations. William W. Mulford. Discusses the organic and logical basis for the three-column form of organization. 4000 w. Engineering Magazine—Nov., 1910. No. 18258 B.

Cost Systems.

Cost Keeping for Small Machine Shops. Sterling H. Bunnell. Explains a simple card system for keeping accurate cost records. 2500 w. Am Mach—Vol. 33. No. 42. No. 17947.

A Simple Foundry Order System. George Muntz. Describes the application of an economical cost-keeping record in a shop employing 80 molders. 1500 w. Foundry—Oct., 1910. No. 17632.

Education.

The Training and Work of an Electrical Engineer. Murray C. Beebe. On the preparation needed for successful work in this field. 2500 w. Wis Engr—Oct., 1910. No. 17941 C.

The Production of Engineers and Higher Technical Education (La Formation des Ingénieurs et l'Enseignement technique supérieur). Georges Bourrey. Read at the International Congress on Technical Education. Criticizes the methods and ideals of engineering education in France. 3000 w. Rev Gen d Sci—Sept. 30, 1910. No. 18007 D.

Glasgow and West Scotland Technical College. John G. Kerr. Illustrated description of the buildings and their equipment is given in this first instalment. 4800 w. Engng—Sept. 23, 1910. Serial. 1st part. No. 17679 A.

Employers' Liability.

The Application of Legislation on Industrial Accidents in France (L'Application de la Législation sur les Accidents du Travail). An abstract of an official report on the working of the law in 1909. 2700 w. Rev d'Econ Indus—Sept., 1910. No. 18000 D.

Engineering.

The Social Problems of the Engineer (Die sozialen Aufgaben der Techniker). G. Lustig. A review and discussion of the socialogical problems which are presented to the engineer for solution or advice. 5000 w. Zeitschr d Oest Ing u Arch Ver—Sept. 9, 1910. No. 18065 D.

Engineers.

Current Professional Topics. Henry C. Adams. Suggestions for increasing the competency of engineers and preventing unqualified men from pretending they are members of the profession. 7000 w. Soc of Engrs—Oct. 3, 1910. No. 17900 N.

Industrial Betterment.

Betterment of Labor Conditions in the Steel Industry. Address by William B. Dickson before the Am. Ir. & St. Inst. Discusses the prevention of accidents, accident relief, and pension funds. 4000 w. Eng Rec—Oct. 29, 1910. No. 18244.

Labor Exchanges.

Labor Exchanges in France. Editorial review of the aim of these agencies and what they have accomplished. 1800 w. Engng—Oct. 14, 1910. No. 18165 A.

Labor Insurance.

Insurances of Workmen in Germany. Otto Graf. Trans. from *Technik und Wirtschaft.* Discusses the results of the statistics of the laws, particularly those published since 1900. 2800 w. Ir & Coal Trds Rev—Oct. 7, 1910. No. 17917 A.

Compulsory State Insurance of Laborers and Its Improvement (Die staatliche Zwangsversicherung der Handarbeiter und deren Verbesserung). Gg. Jehle. A discussion of labor insurance in Germany. Ills. Serial. 1st part. 1800 w. Giesserei-Zeit—Sept. 1, 1910. No. 18043 D.

The Operation of the Mutual Vocational Insurance Companies in Germany from 1885 to 1910 (Das Wesen und Wirken der gewerblichen Berufsgenossenschaften von 1885 bis 1910), Konrad Hartmann. A review of 25 years of labor insurance in Germany. 3500 w. Tech u Wirt—Sept., 1910. No. 18206 D.

Management.

Systematic Foundry Operation and Foundry Costs. C. E. Knoeppel. This second article of a series discusses the principal elements of foundry accounting and management. 4500 w. Engineering Magazine—Nov., 1910. No. 18255 B.

The Twelve Principles of Efficiency. Harrington Emerson. This sixth article of a series discusses the fourth principle—discipline. 6000 w. Engineering Magazine—Nov., 1910. No. 18251 B.

The "Outsider" and the Busy Business-Man. William Perry. Suggestions, from experience, as to their proper relations. 3500 w. Engineering Magazine—Nov., 1910. No. 18259 B.

Obtaining the Co-operation of Men. H. F. J. Porter. Discusses the management of labor in industrial works. 2000 w. Am Mach—Vol. 33. No. 41. No. 17879.

Increasing Shop Output. The importance of having "the right man in the right place," the arrangement of the work, and other suggestions. 1800 w. Ry Age Gaz—Oct. 7, 1910. No. 17745.

Patents.

Notes on Patentability (Neue Beiträge zur Lehre von der Patenfahigkeit). Dr. Schanze. A discussion of the fundamental principles of patent law. Serial. 1st part. 5000 w. Glasers Ann—Sept. 1, 1910. No. 18062 D.

Standardization.

Standardization as a Phase in Engineering Evolution. Discusses its place and value. 3500 w. Met & Chem Engng—Oct., 1910. No. 17764 C.

MARINE AND NAVAL ENGINEERING.

British Merchant Marine.

Leading Companies in the British Merchant Marine (Einige der wichtigsten Schiffahrtsgesellschaften auf Aktien in England). Paul Kratz. A review of British merchant shipping, describing in detail some of the more important companies. Serial. 1st part. 4500 w. Schiffbau—Sept. 14, 1910. No. 18051 D.

Dredges.

See Dredging, under MINING AND METALLURGY, Gold and Silver.

Electric Power.

Application of Electricity to Marine Work. Illustrates and describes the equipment of the works of the John N. Robins Company, Erie Basin Dry Docks, Brooklyn, N. Y. 4500 w. Elec Wld—Oct. 6, 1910. No. 17710.

Electro-Magnetic Transmission for Marine Propulsion. Jules Lecoche. Read before the Inst. of Marine Engrs., at Olympia. Explains the difficulties encountered in combining a reciprocating engine with an exhaust steam turbine, and the advantages of the "magnetic gear." Ills. 2000 w. Mech Engr—Sept. 23, 1910. No. 17667 A.

Internal-Combustion Engines.

The Internal-Combustion Engine. William P. Durtnall. Abstract of a paper read before the Inst. of Marine Engrs., at Olympia. Brief review of the development of the internal-combustion engine, describing types and discussing their faults, and efficiency. Ills. 4500 w. Mech Engr—Oct. 7, 1910. No. 17902 A.

Marine Combustion Motors at the International Motor Boat and Motor Exposition at Berlin, 1910 (Boot- und Schiffsmaschinen für flüssigen Brennstoff auf der Internationalen Motorboot- und Motoren-Ausstellung, Berlin, 1910). A. Heller. Illustrates and describes the more important exhibits. 3500 w. Zeitschr d Ver Deutscher Ing—Sept. 3, 1910. No. 18095 D.

Propellers.

On the Number of Ship's Propellers (Du Nombre des Propulseurs sur les Navires). A. Fournier. From the *Revue Maritime*. Discusses the factors governing the choice of the number of propellers in ship design. 2500 w. Rev Indus—Sept. 10, 1910. No. 18013 D.

Salving.

Stranding of Princess May. An illustrated description of the position of the vessel after running on the rocks of the southern Alaska coast, the method of salvage, and the history of the vessel. 1800 w. Marine Rev—Oct., 1910. No. 17847.

The Army Engineers' Report on Raising the "Maine." Gives important sections of the report and the proposed method of raising the wreck, and recommendations relating to the work. 3000 w. Eng News—Oct. 20, 1910. No. 17958.

Raising the United States Battleship "Maine." Plans and description of methods adopted for exposure of the wreck by a cofferdam of interlocking sheet pile cylinders of steel. 3000 w. Eng Rec—Oct. 22, 1910. No. 18112.

Ship Designs.

The Growth of Steamships. Sir William H. White. Condensed from *London Times Engng. Sup.* A discussion of the tendencies in ship construction believing the future will be governed by commercial considerations. Also editorial. 2500 w. Eng News—Oct. 6, 1910. No. 17719.

The Revolution in Cargo Vessels and Its Influence on Rolling Mills (Die Umwälzung im Handelsschiffbau und ihr

Einfluss auf die Profilwalzwerke). Carl Kielhorn. Discusses the new sections which have been developed to meet the demands of naval architecture. 2000 w. Stahl u Eisen—Sept. 14, 1910. No. 18036 D.

Beam Profiles (Balken-Profile). Arthur R. Liddell. A criticism of the inadequacy of the German structural shapes to the requirements of shipbuilding. Ills. 2500 w. Schiffbau—Sept. 28, 1910. No. 18052 D.

Column Tables for Ship Work. R. Earle Anderson. A review of information relative to column strength, and the conclusions drawn therefrom. 2500 w. Int Marine Engng—Oct., 1910. Serial. 1st part. No. 17692 C.

Ship's Boats.

Life Saving at Sea. Sydney F. Walker. Explains the difficulties in lowering and disengaging boats at sea, discussing davits, and disengaging apparatus. Ills. 2500 w. Int Marine Engng—Oct., 1910. No. 17690 C.

Steamships.

Old American Transatlantic Steam Liners. Francis B. C. Bradlee. An illustrated account of early attempts of transatlantic steam navigation and of the various lines started by Americans. 4500 w. Int Marine Engng—Oct., 1910. Serial. 1st part. No. 17693 C.

New American-Hawaiian Steamers. Illustrated descriptions of three of the best type of American merchant cargo vessels, carrying a limited number of passengers. 1200 w. Int Marine Engng—Oct., 1910. No. 17689 C.

The Portuguese Royal Mail Steamer Lisbon. Illustrated description of a twin screw passenger and mail steamer for service between Portugal and Africa. 1200 w. Int Marine Engng—Oct., 1910. No. 17694 C.

The French Atlantic Liner France. Illustrated description of the largest mercantile vessel yet built in a French yard. 2000 w. Engr, Lond—Oct. 14, 1910. No. 18173 A.

The Launch of the Olympic. Illustrates and describes particulars concerning the machinery of this large vessel, recently launched. Plate. 1800 w. Engr, Lond—Oct. 21, 1910. No. 18301 A.

The White Star Liner "Olympic." Illustrated description of this large liner, its construction, and equipment. Plates. 9500 w. Serial. 1st part. Engng—Oct. 21, 1910. No. 18296 A.

See also Steam Turbines, under MARINE AND NAVAL ENGINEERING.

Steam Turbines.

Turbine Troubles. Especially considers blading troubles and their causes. 3000 w. Engr, Lond—Oct. 21, 1910. No. 18300 A.

The Brown-Curtis Turbine Installation in H. M. S. "Bristol." An illustrated description and review of the performance of this vessel on her trials. Plates. 5000 w. Engng—Sept. 30, 1910. No. 17831 A.

The First Italian Turbine Passenger Steamer. Dagnino Attilio. Illustrates and describes the machinery of the "Citta Di Catania," the first Italian steamer fitted with turbine machinery constructed in Italy. 1200 w. Int Marine Engng—Oct., 1910. No. 17691 C.

Submarines.

Submarines. Simon Lake. Reviews the development, giving accounts of the early vessels of this type and the difficulties encountered. Ills. Discussion. 7500 w. Pro Engrs' Club of Phila, No. 1089—Oct, 1910. No. 18248 D.

The Norwegian Submersible "Kobben" and the Submersibles of the "Germania" Type (Le Submersible Norvégien "Kobben" et les Submersibles du Type "Germania"). Brief illustrated review. 1200 w. Génie Civil—Sept. 24, 1910. No. 18021 D.

Yachts.

Twin-Screw Yacht Lien-Ching. Engraving, drawings and description of a steam yacht of 500-tons displacement. 800 w. Engr, Lond—Oct. 7, 1910. No. 17911 A.

A Shallow Draft Yacht. Plan and detailed description of a triple-screw, shallow-draft tunnel yacht. 1000 w. Int Marine Engng—Nov., 1910. No. 18396 C.

MECHANICAL ENGINEERING.

AUTOMOBILES.

Adams.

New Cars for 1911. Brief illustrated description of the new 16 h.p. Adams car. 1000 w. Auto Jour—Oct. 15, 1910. No. 18149 A.

Argyll.

Argyll. Illustrated description of the 12 h.p. new model for 1911. 1000 w. Auto Jour—Oct. 1, 1910. No. 17802 A.

Chadwick.

The Chadwick for 1911. Four new models, mechanically identical, are illustrated and described. 2500 w. Automobile—Oct. 20, 1910. No. 17964.

Colors.

Automobile Colors. M. C. Hillick. Remarks on popular colors and the methods of applying them. 1000 w. Automobile—Oct. 6, 1910. No. 17733.

Crossley.

The 12-14 h.p. and 20 h.p. Crossley Cars. Illustrated description of new features introduced in the latest types of these cars. 1000 w. Autocar—Oct. 15, 1910. No. 18146 A.

Daimler.

Next Year's Daimlers. Illustrated detailed description of the new 12 h.p. chassis, and features of interest. 1500 w. Autocar—Sept. 24, 1910. No. 17661 A.

New Cars for 1911. Interesting features of the new Daimler cars are illustrated and described. 1500 w. Auto Jour—Sept. 24, 1910. No. 17662 A.

Electric.

Electric Vehicles of the New Oberschöneweide Automobile Company (Elektrische Motorwagen der Neuen Automobil-Gesellschaft in Oberschöneweide bei Berlin). Herr Dierfeld. Brief description of these new cars. Ills. 1200 w. Zeitschr d Ver Deutscher Ing—Sept. 17, 1910. No. 18202 D.

Elmore.

Two-Cycle Elmore. Illustrates and describes "Model 25," made in two types, also improved features of other models. Ills. 3500 w. Automobile—Oct. 6, 1910. No. 17735.

Engineering.

The Automobile. Hermann F. Cuntz. A review of the rapid development, discussing some of the problems and their solution and the field for the mechanical engineer. 6500 w. Stevens Ind—Oct., 1910. No. 17731 D.

Franklin.

Franklin Product and Practices. Illustrates and describes air-cooled motors, methods of manufacture, etc. 1500 w. Automobile—Oct. 27, 1910. No. 18229.

Gears.

Worm Gearing. J. Dalrymple Bell. Discusses the possibilities of a change-speed gearing with helical teeth giving two or more direct drives. Ills. 1500 w. Autocar—Oct. 1, 1910. No. 17804 A.

Ignition.

Double Ignition by Magneto. Illustrated description of a novel two-pole Bosch machine. 1500 w. Auto Jour—Oct. 8, 1910. No. 17890 A.

Lighting.

Electric Light for Cars. Illustrations and outline of the new C. A. V. system for car lighting. 1400 w. Autocar—Sept. 24, 1910. No. 17660 A.

Popularizing Electric Light for Cars. Illustrated description of the latest C. A. V. system. 3000 w. Auto Jour—Oct. 1, 1910. No. 17803 A.

Motor Balancing.

The Balancing of Engines. F. Strickland. Discusses points to be considered, especially the influence of the angle of the connecting rod. 1200 w. Autocar—Oct. 8, 1910. No. 17889 A.

Motor Crank Shafts.

Four-Cylinder Crank Shaft Design. P. M. Heldt. Derives formulae for dimensioning crank shafts for motor car engines from data obtained from actual modern engines. Ills. 800 w. Horseless Age—Oct. 19, 1910. Serial. 1st part. No. 17993.

Motors.

Fresh Fields of Engine Development. Illustrates and describes the novel features possessed by an engine designed by C. Leslie Walker. 2500 w. Auto Jour—Sept. 24, 1910. No. 17663 A.

Novel Two-Cycle Motor. Illustrates and describes Leslie Walker's design of an internal combustion engine which is a new departure in automobile practice. 2000 w. Automobile—Oct. 13, 1910. No. 17852.

The F. H. S. Double Impulse Engine. Illustrates and describes a two-stroke engine embodying new features aiming toward increased efficiency. 1500 w. Autocar—Oct. 15, 1910. No. 18148 A.

The Hewitt Piston Valve Engine. Brief illustrated description of the cycle of operations. 600 w. Autocar—Oct. 15, 1910. No. 18147 A.

Motor Valves.

Some Criticisms of the Slide Valve Engine. Mainly a critical comparison of the slide and poppet systems, by a manufacturer of poppet valve engines. 3500 w. Autocar—Oct. 15, 1910. No. 18145 A.

Rambler.

Rambler Line for 1911. Illustrates and describes features of the output, which includes nine styles, detachable fore-doors, etc. 2500 w. Automobile—Oct. 6, 1910. No. 17732.

Selden.

Selden Mechanically for 1911. Illustrated detailed description of the motor used in the five models. 1500 w. Automobile—Oct. 6, 1910. No. 17734.

Tires.

Care and Repair of Tires. Discusses the expense and importance of the tire problem, giving suggestions and precautions. Ills. 2000 w. Automobile—Oct. 27, 1910. No. 18228.

Sectional Tire Construction. Brief illustrated description of the Margett sectional pneumatic tire. 1500 w. Auto Jour—Oct. 15, 1910. No. 18150 A.

Traction Engines.

Tests of Traction Engines at Winnipeg, Canada. Tabulated results, with explanatory notes. 1500 w. Eng News—Oct. 27, 1910. No. 18194.

Combination Gasoline Traction Engine with Ditcher Wheel Attachment. Frank C. Perkins. Illustrated description of a machine of American construction. 1000 w. Sci Am—Oct. 29, 1910. No. 18236.

Transmissions.

See Gears, under MACHINE ELEMENTS AND DESIGN.

COMBUSTION MOTORS.

Aeronautic Motors.

Aviation and Aeroplane Motors. Henri Petit. Trans. from *La Nature*. Detailed analysis of the essential features of the power plant equipment suggesting a probable solution of the problems of future development. Ills. 2000 w. Jour Fr Inst—Oct., 1910. No. 17936 D.

The Testing of Aeronautic Motors (Les Essais des Moteurs d'Aviation). A. Boyer-Guillon. Discusses purpose, apparatus, and methods. 2000 w. Rev de Mécan—Sept., 1910. No. 18004 E + F.

Gas Cleaning.

The Necessity of Thoroughly Cleansing Producer Gas. L. L. Brewster. Gives some results of inadequate cleaning and suggests a form of sprayer for use in the wet scrubber. 1500 w. Power—Oct. 4, 1910. No. 17653.

See also Blast-Furnace Gas, under MINING AND METALLURGY, Iron and Steel.

Gas-Engine Efficiency.

The Advance of Gas Engines. G. A. Julius. Abstract of paper read before the Engng. Assn. of N. S. W. A discussion of their commercial efficiency. 4500 w. Aust Min Stand—Sept. 21, 1910. Serial. 1st part. No. 18143 B.

Gas-Engine Governors.

Modern Governing Mechanisms. Warren H. Miller. Illustrates and describes various types of gas-engine governors. 1500 w. Power—Oct. 18, 1910. No. 17925.

Gas Engines.

The Development of Large Gas Engines. Remarks on the remarkable development during the last ten years, and information concerning the industries using them. Diagrams. 3000 w. Ir & Coal Trds Rev—Oct. 14, 1910. No. 18174 A.

Cooling Gas Engines. George J. Murdock. Illustrated description of a new cooling device and its operation, claiming great economy. 2000 w. Mach, N Y—Oct., 1910. No. 17646 C.

Gasoline Engines.

The Petrol Engine. Prof. W. Watson. Describes briefly some typical forms introductory to a discussion of the principles common to all petrol engines. Ills. 6500 w. Jour Soc of Arts—Sept. 23, 1910. Serial. 1st part. No. 17658 A.

Gas Power Plants.

A Small Power Plant with Modern Features. L. L. Brewster. Illustrated description of a 500-h.p. modern gas engine plant, with bituminous producers. 1600 w. Power—Oct. 11, 1910. No. 17793.

The Performance of a Gas Engine and Suction Producer Plant, Engaged in Public Lighting Work in South Africa. Harry W. Miller. Gives results achieved with a plant for generating electric energy for lighting the town of Bethlehem, in the Orange Free State. Also discussion. 5800 w. Jour S African Assn of Engrs—Aug., 1910. No. 17659 F.

See also Central Stations, under ELECTRICAL ENGINEERING, Generating Stations.

Gas Producers.

Recent Progress in the Construction of Suction Gas Producers. R. W. Hilgenstock. Brief description of two new producers and results obtained. Ills. 1200 w. Am Gas Lgt Jour—Oct. 10, 1910. No. 17788.

New Producers for Bituminous Coal (Neuere Generatoren für bituminöse Brennstoffe). Herr Gwoodz. Describes in detail recent types. Ills. Serial. 1st part. 3000 w. Glückauf—Sept. 17, 1910. No. 10849 D.

Oil Engines.

Oil Engines Driving Centrifugal Pumps in the Copenhagen Water Works (Dieselmotoren mit Kreiselpumpen im Wasserwerk der Stadt Kopenhagen). A. Olivarius. Illustrated description of the installation. Serial. 1st part. 1200 w. Zeitschr f d Gesamte Turbinenwesen—Sept. 20, 1910. No. 18059 D.

See also Central Stations, under ELECTRICAL ENGINEERING, Generating Stations.

HEATING AND COOLING.

Air Purification.

The Mechanical Purification of Air. C. L. Browne. Describes apparatus for filtering and washing air. Ills. 4000 w. Cassier's Mag—Oct., 1910. No. 17698 B.

Cooling Towers.

The Theory of the Cooling Tower. Joseph H. Hart. Shows how the cooling effect is obtained by absorption, condensation, convection, and radiation. 2500 w. Power—Oct. 4, 1910. No. 17650.

Hot-Air Heating.

School Fan Furnace-Heating Plant. Plans and description of an installation using both a plenum and an exhaust fan. 1500 w. Met Work—Oct. 8, 1910. No. 17765.

Refrigeration.

The Absorption Refrigerating System. F. E. Matthews. Illustrates and describes the various elements of this system. 2500 w. Power—Oct. 25, 1910. No. 18137.

Types of Ammonia Compressors. F. E. Matthews. Illustrates and describes typical examples of double and single acting ammonia compressors. 1000 w. Power—Oct. 4, 1910. No. 17649.

Refrigeration in the Blackstone Hotel. Illustrated general description of the refrigerating plant and air-cooling system of a large Chicago hotel. 2000 w. Ice & Refrig—Oct., 1910. No. 17688 C.

The Municipal Abattoir at Paris, Texas. Description and views of plant and equipment, including the refrigerating plant. 2000 w. Ice & Refrig—Oct., 1910. No. 17687 C.

A Novel Refrigerating Plant in a French Mine. Dr. Alfred Gradenwitz. Illustrates and describes a plant recently installed at mines of Béthune, France. 1500 w. Min Wld—Oct. 15, 1910. No. 17882.

Steam Heating.

Heating and Ventilating a Ten-Story Bank Building. Illustrated description of the system of heating and ventilation adopted for the Boston Safe Deposit and Trust Co. A combination of the Webster "modulation" direct heating and the indirect fan heating system. 1500 w. Heat & Vent Mag—Oct., 1910. No. 18129.

See also Exhaust Steam, under STEAM ENGINEERING.

Ventilation.

Hygienic Principles of Ventilation. W. A. Evans, in the *Medical Rec.* Enumerates important features of improving indoor air conditions. 2500 w. Met Work —Oct. 22, 1910. No. 17991.

HYDRAULIC MACHINERY.

Air Lift.

Air Lift Pumping. Edward A. Rix, in *The Oil Industry.* Explains general terms used, giving diagrams, tables, formulae and information. 1200 w. Min & Sci Pr —Oct. 15, 1910. No. 17997.

Centrifugal Pumps.

Recent Developments in Centrifugal Pumps (Neuere Ausführungen von Kreiselpumpen). Ernst Blau. Describes and reports the performance of a number of large, high-lift units for mining work. Ills. 1000 w. Zeit d Oest Ing u Arch Ver —Sept. 23, 1910. No. 18066 D.

See also Oil Engines, under COMBUSTION MOTORS.

Hydrodynamics.

Experiments on the Conversion of Water Velocity into Pressure (Versuche über die Umsetzung von Wassergeschwindigkeit in Druck). K. Andres. Describes the test apparatus and gives the results. Ills. Serial. 1st part. 3300 w. Zeitschr d Ver Deutscher Ing—Sept. 17, 1910. No. 18201 D.

Hydrodynamo.

The Fallacy of the Hydrodynamo. The device is illustrated and described and its fallacy pointed out. 800 w. Power—Oct. 18, 1910. No. 17923.

Pump Design.

Notes on the Design of Reciprocating Pumps. A. Marshall Attack. Discusses points that affect the choice of design, and details of different types. Ills. 1200 w. Mech Wld—Oct. 7, 1910. Serial. 1st part. No. 17903 A.

Pumping Plants.

The Salt Lake Sewage Pumping Station. Illustrated detailed description of a station equipped with a duplicate power and pumping outfit. A gas-producer outfit and an electric installation inter-connected to the two pumping units insure constant operation. 900 w. Eng Rec—Oct. 8, 1910. No. 17774.

See also Pumping, under MINING AND METALLURGY, MINING.

Turbine Buckets.

A Graphical Method of Designing Turbine Buckets (Kreis-Trajektorien, ein Ersatz für exakte Stromfunktionen). Johannes Lüttmann. Describes a method of designing turbine buckets by geometrical construction. Ills. Serial. 1st part. 1500 w. Zeitschr f d Gesamte Turbinenwesen —Sept. 10, 1910. No. 18058 D.

Valves.

The Largest Valves in the World. Illustrated description of the 9-foot gate valves for the control of hydraulic turbines of 12000-h.p. each, made for the Ontario Power Co. 800 w. Am Mach—Vol. 33. No. 42. No. 17943.

MACHINE ELEMENTS AND DESIGN.

Ball Bearings.

The Friction of Ball Bearings. Trans. from *La Vie Automobile.* An illustrated account of experimental investigations. 1500 w. Prac Engr—Sept. 23, 1910. Serial. 1st part. No. 17825 A.

Clutches.

On the Design of Multiple Disc Clutches. Eugene P. Batzell. Gives a diagram intended for the quick determination of suitable dimensions for such clutches, with formulae and methods. 3500 w. Horseless Age—Oct. 12, 1910. No. 17877.

Drawings.

Photographic Reproduction of Drawings (Photographische Reproduktionen von Zeichnungen). Werner Ahrens. Discusses methods of filing and indexing photographic reproductions of working drawings. Ills. 2200 w. Tech u Wirt—Sept., 1910. No. 18207 D.

Gears.

Gear Tooth Standards and Comparisons. Diagrams, tables, and explanatory notes. 500 w. Engr, Lond—Oct. 14, 1910. No. 18171 A.

Design of Automobile Transmission Gears. M. Terry. Discusses some of the main principles common to all gear transmissions. 3000 w. Mach, N Y—Oct., 1910. Serial. 1st part. No. 17636 C.

Gycroscope.

A New Theory of the Gyroscope and Its Practical Application (Eine neue Theorie des Kreisels und seine Anwendung in der Technik). A. Fuchs and R. Katzmayr. Presents a simple theory of the action of the gyroscope and outlines practical applications. Ills. Serial. 1st part. 7200 w. Zeitschr d Ver Deutscher Ing—Sept. 10, 1910. No. 18098 D.

Riveted Joints.

The Strength of Spiral Riveted Joints. John Jasky. Mathematical determination.

700 w. Boiler Maker—Oct., 1910. No. 17753.

Vice.

An Improved Vice. The invention of R. W. & L. H. Bateman of Leeds, is illustrated and described. 800 w. Prac Engr—Sept. 23, 1910. No. 17665 A.

MACHINE WORKS AND FOUNDRIES.

Brass Founding.

Brass Foundry Progress. Charles T. Bragg. Read before the Am Brass Found.'s Assn. Reports the development, and the value of chemical control. 1200 w. Foundry—Oct., 1910. No. 17634.

Yellow Brass Chips and Their Relation to the Manufacture of Brass Ingot. Information concerning brass chips and the contaminating material found in them. Ills. 1000 w. Brass Wld—Oct., 1910. No. 17970.

Why Crucibles Often Fail. Walter J. May. Brief explanation of causes. 700 w. Prac Engr—Oct. 7, 1910. No. 17899 A.

See also Metallography, under MATERIALS OF CONSTRUCTION.

Casehardening.

Casehardening for Colors. E. R. Markham, in *Southern Machinery*. Gives methods of producing colors on iron and steel. Ills. 1600 w. Mech Engr—Sept. 30, 1910. No. 17828 A.

Castings.

Iron Castings: Defects and Remedies. Robert Job. Read before the Canadian Ry. Clubs. Discusses causes of hardness and the remedy, porous, spongy iron, and other defects. 2000 w. Can Engr—Oct. 13, 1910. No. 17875.

Chip Briquetting.

The Briquetting of Metal Chips (Die Brikettierung von Eisen- und Metallspänen). Erich Schumacher. Describes the Ronay process and gives some results. Ills. 1500 w. Giesserei-Zeit—Sept. 15, 1910. No. 18044 D.

Dies.

Out-of-Date Die-Making Methods. Critical comments on an article by F. E. Shailor in the June issue, on this subject. 3800 w. Mach, N. Y—Oct., 1910. No. 17645 C.

Bending Dies for the Ribbon Forks of the Ellis Adding Typewriter. Ralph E. Flanders. Illustrates and describes tools used and their action. 1500 w. Mach, N Y—Oct., 1910. No. 17640 C.

Drilling Machines.

A High Powered Close Drive. John Squires. Brief illustrated description of a drill drive of high power, where compactness was important. 800 w. Am Mach—Vol. 33. No. 42. No. 17944.

Foundries.

Typical Modern Foundry Layouts. First of a series of articles illustrating and describing the general arrangement and equipment of gray iron foundries of varying capacities. 1200 w. Foundry—Oct., 1910. Serial. 1st part. No. 17628.

The Mesta Machine Company's Foundry. Plans, sections and general description of this foundry at Pittsburgh, Pa. 1200 w. Eng Rec—Oct. 8, 1910. No. 17771.

A Large Milwaukee Steel Casting Plant. Illustrated description of the equipment and arrangement of the Falk Co.'s foundry, using the open-hearth process. 1500 w. Foundry—Oct., 1910. No. 17631.

Casting Large Propellers in Monel Metal. Illustrated description of work at a plant in Bayonne, N. J., devoted exclusively to the melting of this comparatively new alloy of nickel and copper. 1200 w. Foundry—Oct., 1910. No. 17633.

Foundry Buildings.

Foundry Buildings (Giessereihallenbauten). R. Lots. Discusses the influence of temperature variations on buildings. Serial. 1st part. 1800 w. Giesserei-Zeit—Sept. 1, 1910. No. 18040 D.

Foundry Furnaces.

The Electric Furnace: It's Utility for Castings. W. S. Gifford. Abstract of paper before the British Found. Assn. A brief review of what has been accomplished in this application. 1000 w. Elec Engr, Lond—Sept. 23, 1910. No. 17674 A.

The Design of Reverberatory Furnaces for Foundries (Giessereiflammöfen und ihre Berechnung). Bernhard Osann. Describes their design, calculation of charge, and operation. Ills. 5200 w. Stahl u Eisen—Sept. 7, 1910. No. 18034 D.

Muffle Furnaces for Enamelling and other Purposes (Muffelöfen für Emaillierwerke und andere industrielle Zwecke). Ernst A. Schott. Describes a number of types. Ills. 5200 w. Stahl u Eisen—Sept. 7, 1910. No. 18035 D.

Foundry Materials.

The Valuation of Pig Iron. J. H. Linton. Shows that the value depends on the chemical composition. 1200 w Foundry—Oct., 1910. No. 17630.

Foundry Practice.

Car Wheel Foundry Practice: Canadian Pacific. George L. Fowler. Illustrated description of the foundry, its equipment, methods and results. 4500 w. Ry Age Gaz—Oct. 7, 1910. No. 17748.

Furnaces.

The Hawley Automatic Annealing Furnace. Illustrates and describes a recent model in which electric motors control all operations. 1500 w. Ir Age—Oct. 20, 1910. No. 17995.

The Introduction of the Gas Furnace. Charles F. Stamps. Read before the Pacific Coast Gas Assn. Brief consideration of the general principles of construction, and the causes of their slow development. 1200 w. Am Gas Lgt Jour—Oct. 10, 1910. No. 17789.

Galvanizing.

Galvanizing Malleable Castings (Verzinkung von Tempergussstücken). O. Beckmann. A brief review of methods and apparatus. Ills. Serial. 1st part. 1600 w. Giesserei-Zeit—Sept. 1, 1910. No. 18041 D.

Gear Cutting.

Making Hindley Worm Gears. Charles H. Logue. An account of an experience in cutting Hindley worm gears that showed the points of interference. 1800 w. Am Mach—Vol. 33. No. 43. No. 18185.

Grinding.

Grinding Reamers and Milling Cutters. George W. Burley. The present number considers mainly the disc wheel and its use. 1500 w. Mech Wld—Sept. 23, 1910. Serial. 1st part. No. 17671 A.

Grinding Machines.

The Blanchard Vertical Spindle Surface Grinder. Description of a machine combining great power and accuracy. Ills. 2500 w. Ir Age—Oct. 13, 1910. No. 17837.

Lathes.

Comparisons Between English and American Lathe Design. G. W. Burley. Read before the Sheffield Soc. of Engrs. & Met. A comparison and discussion of practice and design in the two countries. 2500 w. Mech Wld—Oct. 7, 1910. No. 17904 A.

Two Large Double-Bedded Lathes. Illustrates and describes two lathes of unusual proportions, built in Manchester, England. 700 w. Engr, Lond—Sept. 30, 1910. No. 17834 A.

The Calculation of Step Pulleys for Ruppert Drive (Zeichnerische Bestimmung der Stufenräder für Ruppertgetriebe). Hans Volkmann. Mathematical discussion of the design of speed-changing gears for this type of drive. Ills. 3000 w. Zeitschr f Werkzeug—Sept. 5, 1910. No. 18063 D.

Machine Tools.

Depreciation of Machine Tools. W. W. Bird. Discusses the factors, analyzing the problem from the second-hand dealer's point of view, and offering suggestions. 3000 w. Am Mach—Vol. 33. No. 43. No. 18186.

Suggestions to Users of Machine Tools. A. J. Larmon. Urges the necessity of leveling machines, especially across the shears before bolting them to the floor, and of trying them after several months operation. Other useful suggestions. 1000 w. Ir Age—Oct. 6, 1910. No. 17750.

Special Automobile Tool Equipment. T. A. Sperry. Illustrates and describes methods employed in building the Marmon cars. 1200 w. Am Mach—Vol. 33. No. 40. No. 17707.

Milling.

Milling Cutter Practice at the Juniata Shops. Ralph E. Flanders. Illustrates and describes points in cutter practice. 1500 w. Mach (Ry Ed)—Oct., 1910. No. 17801 C.

See also Grinding, under MACHINE WORKS AND FOUNDRIES.

Molding.

Pattern and Mold for Odd Shape. Joseph G. Horner. Describes the building of the pattern, core box, and mold for an unusual shaped casting. Ills. 1500 w. Am Mach—Vol. 33. No. 40. No. 17709.

Molding Machines.

Bonvellain and Ronceray's Patent Universal Machine-Moulding System. Illustrated detailed description of this system, the moulding machines and appliances used. Plates. 6000 w. Engng—Oct. 14, 1910. No. 18164 A.

Molding Sand.

A Screenless Ball Mill for Foundries (Sieblose Kugelmühle mit Windsichtung für Giessereizwecke). Friedr. Meyer. Describes a new type of mill for the preparation of molding sand. Ills. 2000 w. Giesserei-Zeit—Sept. 15, 1910. No. 18042 D.

Planers.

The Knecht Rapid Production Planer. Illustrates and describes a planer with many novel features. 3500 w. Am Mach—Vol. 33. No. 40. No. 17706.

Pneumatic Tools.

The Hessenmüller Pneumatic Hammer with Oscillating Cylinder (Luftfederhammer mit bewegtem Zylinder, Bauart Hessenmüller). U. Lohse. Illustrated detailed description. 3500 w. Zeitschr d Ver Deutscher Ing—Sept. 17, 1910. No. 18200 D.

Shop Accidents.

Prevention of Accidents in the Shop. Gives hints suggested by the Fidelity and Casualty Co., New York. 2500 w. Ry Mas Mech—Oct., 1910. Serial. 1st part. No. 17851.

Shop Lighting.

Illumination as a Factor in Manufacturing Costs. A. S. Hubbard. Extract from a paper read before the Nat. Assn. of Cotton Mfrs. Remarks on the eye and its functions and the general conditions of light affecting its use, especially presenting the advantages claimed for the Cooper Hewitt lamps. 3800 w. Elec Rev, N Y—Oct. 1, 1910. No. 17599.

Shop Practice.

Automobile Factory Practice. Ethan Viall. Illustrates and describes methods used at the works of Haberer & Co., Cincinnati, Ohio. 1200 w. Mach, N Y—Oct., 1910. No. 17639 C.

Machining a Motor Fly-Wheel. Edward J. Blanchard. Illustrates and describes machining on a No. 3-A Potter & Johnston automatic turret machine. 2000 w. Mach, N Y—Oct., 1910. No. 17641 C.

Making Automobile Radiators. Ethan Viall. Illustrated detailed description of methods used for the perforated fin-and-tube type. 800 w. Mach, N Y—Oct., 1910. No. 17637 C.

Examples of Modern Turning Practice in Automobile Construction. Illustrates and describes interesting examples. 2000 w. Mach, N Y—Oct., 1910. No. 17642 C.

Making Roller Bearings. Ethan Viall. Illustrations, with explanatory notes. 500 w. Mach, N Y—Oct., 1910. No. 17644 C.

Making Pneumatic Tube Sections. F. A. Stanley. Illustrates and describes methods of boring, milling, drilling, and grinding cast-iron pipe sections of various shapes. 2000 w. Am Mach—Vol. 33. No. 42. No. 17946.

The Operation and Manufacture of Magnetos. Harold Whiting Slauson. The present number explains the principles of a number of types of magneto generators. 2500 w. Mach, N Y—Oct., 1910. Serial. 1st part. No. 17638 C.

Shop Kinks. Illustrates and describes devices and methods used in a number of shops. 800 w. Ry Age Gaz—Oct. 7, 1910. No. 17749.

Shops.

The Works of Escher Wyss & Co. F. R. Low. Illustrations and descriptive notes on the construction of Zoelly turbines, rotary air compressors and water wheels. 2000 w. Power—Oct. 25, 1910. No. 18135.

Tempering.

Safety in Hardening Large Die Blocks. C. U. Scott. Illustrates and describes a method of handling which avoids risks and produces uniformly satisfactory results. 2500 w. Ir Trd Rev—Oct. 20, 1910. No. 17962.

Welding.

Autogenous Welding. Henry Cave. History and description of the process and its applications. Ills. 1000 w. Yale Sci M—Oct., 1910. No. 18224 C.

Electric Butt Welding. A. E. Buchenberg. General discussion of electric butt welding as opposed to brazing and the ordinary forge method of lap welding with particular reference to shop requirements. Ills. 3500 w. Mach, N Y—Oct., 1910. No. 17643 C.

Electric Welding (L'Assemblage des Pièces métalliques à l'Aide du Courant électrique). Bruno Loewenherz. Describes an electric-welding machine and illustrates many applications. 2000 w. L'Elecn—Sept. 10, 1910. No. 18009 D.

MATERIALS OF CONSTRUCTION.

Alloys.

Some Common Defects Occurring in Alloys. Cecil H. Desch. Read before the Inst. of Metals. Classifies some common defects discussing their causes. 4000 w. Mech Engr—Sept. 30, 1910. No. 17829 A.

Linotype, Monotype, Stereotype and Electrotype Metals and Their Manufacture. Discusses their making from new metals, and from old metals. Ills. 1200 w. Brass Wld—Oct., 1910. No. 17972.

The Pyrophoric Alloys and Their Employment in the Manufacture of Modern Tinder Boxes (Les Alliages pyrophoriques et leur Emploi dans la Fabrication des Briquets modernes). Richard Böhm and Paul Nicolardot. Describes various alloys and the apparatus made from them. Ills. 2500 w. Génie Civil—Sept. 17, 1910. No. 18020 D.

See also Foundries, under MACHINE WORKS AND FOUNDRIES.

Brass.

The Heat-Treatment of Brass. G. D. Bengough and O. F. Hudson. Read before the Inst. of Metals. A study of the effects of heat-treatment on rolled and drawn 70:30 brass of varying size of section. 4500 w. Engng—Sept. 23, 1910. No. 17680 A.

Carborundum.

Metallic Silicides: The Action of Carbide of Silicon on Certain Metallic Oxides (Siliciures métalliques: Action du Carbure de Silicium sur quelques Oxydes métalliques). L. Baraduc-Muller. Reports an exhaustive research on the chemical stability of carborundum. Ills. 75000 w. Rev de Métal—Sept., 1910. No. 18003 E + F.

Cast Iron.

The Physical Properties of Cast Iron. John Jermain Porter. Read before the Am. Found. Assn. A discussion of the static and dynamic strength of gray iron, its elastic properties, grain structure, etc. 5000 w. Foundry—Oct., 1910. Serial. 1st part. No. 17629.

The Influence of Silicon on Pure Cast Iron. Arthur Hague and Prof. Thomas Turner. Read before the Iron & Steel Inst. An experimental study of the effect of varying proportions of silicon on the volume and temperature changes, during the cooling of a pure high-carbon iron alloy. Ills. 5000 w. Ir & Coal Trds Rev—Sept. 30, 1910. No. 17813 A.

Manganese in Cast Iron and the Volume Changes During Cooling. H. I. Coe. Read before the Iron & Steel Inst. An account of research work dealing with the effect of manganese on white iron and on gray iron. Ills. 10800 w. Ir & Coal Trds Rev—Sept. 30, 1910. No. 17810 A.

Copper.

The Influence of Impurities on the Properties of Copper. F. Johnson. Notes on the effects of arsenic, lead, nickel, bismuth, cobalt, antimony, tellurium, iron, tin, silver, sulphur, oxygen, etc., with micrographs. 5000 w. Met & Chem Engng—Oct., 1910. No. 17760 C.

Fatigue.

Some Experiments on Fatigue of Metals. J. H. Smith. Read before the Iron & Steel Inst. An illustrated account of a series of experiments upon the fatigue of metals carried out in Belfast. 11000 w. Ir & Coal Trd Rev—Sept. 30, 1910. No. 17818 A.

Metallography.

Sulphurous Acid as a Metallographic Etching Medium. S. Hilpert and E. Colver-Glauert. Read before the Iron & Steel Inst. Reports researches and results obtained with this reagent. Ills. 2500 w. Ir & Coal Trds Rev—Sept. 30, 1910. No. 17811 A.

Theory of Hardening Carbon Steels. C. A. Edwards. Read before the Iron & Steel Inst. Discusses the subject with the hope of merging the theories of the "carbonist" and the "allotropist" and sinking the difference which now exists. Ills. 6500 w. Ir & Coal Trds Rev—Sept. 30, 1910. No. 17812 A.

Metallography in the Brass Foundry. H. S. Primrose. Read before the Inst. of Metals. An illustrated article discussing cases in workshop practice in which examination of defective castings has been useful in discovering the causes of the defects. 3500 w. Foundry—Oct., 1910. No. 17635.

Silver.

Blistering of Sterling-Silver During Annealing. Describes methods of annealing silver and the causes of blister. Ills. 1000 w. Brass Wld—Oct., 1910. No. 17971.

MEASUREMENT.

File Testing.

The Testing of Files. Prof. W. Ripper. Read before the British Assn. Outlines an investigation of results of tests made on the Hubert file-testing machine, which led to improvements in the machine. Also editorial. Ills. 3000 w. Mech Engr—Sept. 23, 1910. No. 17668 A.

Gages.

A New System of Screw Limit Gages. William Taylor. Considers the defects of the common form of gage and illustrates and describes the Taylor screw gage. 1000 w. Am Mach—Vol. 33. No. 41. No. 17880.

Hardness.

Hardness and Its Measurement. G. A. Roush. A comparison of hardness data and other physical tests on the alloys of nickel, copper, and Monel metal with electrolytic iron. 1500 w. Met & Chem Engng—Oct., 1910. No. 17761 C.

Scleroscope Tests for Hardness (Die Kugelfallprobe). John J. Schneider. Discusses the scleroscope method of hardness testing, the significance and accuracy of the results, etc. Ills. 6000 w. Zeitschr d Ver Deutscher Ing—Sept. 24, 1910. No. 18204 D.

Spectroscope.

Auto-Collimating Prism and Spectrograph. Prof. C. Féry. Illustrated description of the instrument. 1500 w. Engng—Oct. 7, 1910. No. 17910 A.

Units.

New Units in Aero-physics. Alexander McAdie. Discusses the need of new units for the measurement of atmospheric pressure, temperature, humidity, etc. 2000 w. Am Jour of Sci—Oct., 1910. No. 17930 D.

Water.

Flow Measurement by Means of the Pitot Tube. Shows the value of the Pitot tube as a gauging instrument, giving explanation of its use. Ills. 1200 w. Surveyor—Oct. 14, 1910. No. 18160 A.

POWER AND TRANSMISSION.

Air Compressors.

Hydraulic Air Compression. Particulars, with illustrations, in regard to the hydraulic air compressor at Ragged Chutes, Canada. 2200 w. Mines & Min—Oct., 1910. No. 17611 C.

Belt Driving.

The Mechanical Transmission of Power. J. B. M. Knutsen. First of a series of four papers, including devices for transmitting power by means of frictional contact between two comparatively smooth surfaces. Driving belts, ropes, bands of steel, flat-faced friction gears, grooved friction gears, etc. Ills. 1500 w. Aust Min Stand—Sept. 21, 1910. Serial. 1st part. No. 18144 B.

Electric Driving.

Electric Driving in Textile Mills. L. Crouch. A study of the requirements and results obtainable, showing that several slight alterations in the design of textile machines are advisable to secure the full advantages of electrical operation. 2000 w. Elec Rev, Lond—Sept. 23, 1910. Serial. 1st part. No. 17675 A.

Lubrication.

Notes on Economical Lubrication. Notes from an address by William M. Davis, before the Nat. Assn. of Cotton Mfrs. Discusses the selection of proper lubricants, their cost and use. 2500 w. Eng Rec—Oct. 1, 1910. No. 17589.

Power Plants.

Large Southern Cotton Mill Plant. Warren O. Rogers. Illustrated description of the mechanical equipment of a plant supplying power for two 75,000 spindle mills. 1500 w. Power—Oct. 18, 1910. No. 17921.

STEAM ENGINEERING.

Boiler Draft.

Effect of Forced Draft on Boiler Capacity and Economy. A discussion, by C. E. Roehl, of the influence of forced draft, forming a part of a committee report presented to the Am. St. & Int. Ry. Engng. Assn. on Oct. 11. 2000 w. Eng Rec—Oct. 22, 1910. No. 18113.

Boiler Evaporation.

Evaporation in Steam Boilers. John Green. Discusses the efficiency of the furnace and boiler and the effect upon the evaporative power. 3000 w. Boiler Maker—Oct., 1910. No. 17751.

Boiler Firing.

An Improved Liquid-Fuel Firing System. Describes a system invented by T. A. & W. E. Savery, of Birmingham, Eng., designed to provide for more efficient use of liquid fuel in steam boilers. Ills. 1200 w. Prac Engr—Sept. 23, 1910. No. 17664 A.

Boiler Fittings.

Development of the Blowoff Valve. Charles J. Simeon. Illustrated description of leading blowoff valves of gate and Y types. 1000 w. Power—Oct. 25, 1910. No. 18136.

Boiler Management.

Externally-Fired Boilers at Ironworks in Collieries. Remarks on the management of such boilers and their dangers. 1600 w. Col Guard—Oct. 7, 1910. No. 17906 A.

Boilers.

The Largest Boilers in Existence. Describes a large Sterling boiler installed at the Delray station of the Detroit Edison Co. Ills. 500 w. Power—Oct. 11, 1910. No. 17794.

Boiler Testing.

Standardization of the Boiler Room. William A. Russell. Gives a method of making standardization tests of the performance of a boiler whereby coal can be bought on a B. t. u. basis to suit any market prices. 2500 w. Power—Oct. 18, 1910. No. 17922.

Boiler Tests.

Evaporative Tests of a Nicolson Boiler. Michael Longridge. From the Chief Engr's report for 1909, of the British Engine, Boiler, and Elec. Ins. Co., Ltd. Sectional view with report of tests. 6000 w. Mech Engr—Oct. 14, 1910. No. 18162 A.

Engine Condensation.

The Entropy Diagram in the Study of Condensation (El Diagrama entropico en el Estudio de la Condensacion). A mathematical demonstration of its application to condensation problems. Ills. 2000 w. Energia Elec—Sept. 25, 1910. No. 18031 D.

Engine Economy.

The Influence of Superheating and Vacuum on Steam Consumption (Der Einfluss der Ueberhitzung und des Vakuums auf den Dampfverbrauch). Jar. Hybl. A summary of conclusions drawn from the results of recent extended experiments. Ills. 1500 w. Zeitschr d Ver Deutscher Ing—Sept. 10, 1910. No. 18099 D.

Engine Governor.

Safety Stops for Steam Engines. W. H. Wakeman. Illustrates and describes most of the safety devices used in connection with the engine governor, explaining their action. 3500 w. Power—Oct. 18, 1910. No. 17924.

Engine Lubrication.

Cylinder Lubrication in Large Engines (Le Graissage des Cylindres et des Machines à grande Puissance). Clément Berger. Discusses the increasing importance of the problem of cylinder lubrication with increasing size of engines. 2500 w. Rev Indus—Sept. 10, 1910. No. 18014 D.

Engine Pistons.

Leakage Through a Piston Valve. George Mitchell. Illustrates and describes methods of testing piston valves of small steam engines for leakage. 4500 w. Power —Oct. 11, 1910. No. 17791.

Engine Reconstruction.

Tripling an Old Beam Engine. Explains conditions at the Bromford Ironworks, and the reasons for tripling the beam engine, describing the work. Ills. 1200 w. Engr, Lond—Oct. 14, 1910. No. 18169 A.

Engines.

The Predecessors of Watt's Engine. H. W. Dickinson. Gives salient points in the history of the atmospheric engine of Thomas Newcomen, which preceded Watt's steam engine. Ills. 1700 w. Power—Oct. 4, 1910. No. 17648.

The Evolution of the Steam Engine (Evolution pratique de la Machine à Vapeur). M. A. Mallet. A history of the steam engine from its origin to the present day, with special reference to the development of compounding. Ills. Serial. 1st part. 28000 w. Mem Soc Ing Civ de France—Aug., 1910. No. 18016 G.

European Lift-Valve Engines. Warren H. Miller. An illustrated review of advanced practice. 2500 w. Engineering Magazine—Nov., 1910. No. 18254 B.

The Walschaerts-Recke Steam Engine (La Machine à Vapeur Walschaerts-Recke). Describes a novel engine exhibited at Brussels. Ills. 2000 w. Rev Indus—Sept. 3, 1910. No. 18012 D.

Engine Stresses.

Inertia Stresses in Reciprocating Engines with Oscillating Cylinders (Le Forze d'Inerzia nelle Macchine a Stantuffo col Cilindro mobile). A. Anastasi. A mathematical study of the stresses due to inertia in engines of this type. Ills. 3000 w. Ann d Soc d Ing e d Arch Ital—Aug. 15, 1910. No. 18024 F.

Engine Tests.

Trials of a Horizontal Compound Tandem Engine. Michael Longridge. Extract from the annual report for 1909 of the British Engine, Boiler, & Elec. Ins. Co., Ltd. Gives results of the trials with explanatory comment. 1000 w. Mech Engr—Sept. 23, 1910. No. 17669 A.

Exhaust Steam.

The Utilization of Exhaust Steam from High-Pressure Engines (Die Verwendung von Abdampf aus Hochdruckmaschinen). Herr Recke. A discussion of the economy of exhaust-steam heating. Ills. 3500 w. Zeitschr d Ver Deutscher Ing—Sept. 24, 1910. No. 18205 D.

See also Turbines, under STEAM ENGINEERING.

Fuel Purchasing.

See Boiler Testing, under STEAM ENGINEERING.

Fuels.

Practical Fuel Values. W. P. Young. Considers qualities that add to or subtract from the value of coal for special uses. 2000 w. Mines & Min—Oct., 1910. No. 17620 C.

Loss in Coal Due to Excess Air. H. J. Westover. Gives simple method of determining the proper amount of air for complete combustion. 2000 w. Power—Oct. 11, 1910. No. 17792.

Stacks.

Natural Draft and Chimney Design. H. G. Brinkerhoff. Abstract of paper read before the Nat. Assn. of Cotton Mfrs. Considers the factors affecting the dimensions of chimneys. 1400 w. Power —Oct. 4, 1910. No. 17651.

Superheating.

The Improvement of Steam Plant Efficiency. Carl C. Thomas. An outline of the history and early development of superheating, with a review of some of the difficulties encountered in its application. 5500 w. Wis Engr—Oct., 1910. No. 17940 C.

See also Engine Economy, under STEAM ENGINEERING.

Turbine Design.

Blade Proportioning in Reaction Type Steam Turbine. Ernest R. Briggs. A study of design. 1200 w. Engr, Lond—Sept. 23, 1910. Serial. 1st part. No. 17682 A.

The Calculation of Steam-Turbine Bases and Drums (Beitrag zur Berechnung von Dampfturbinen-Zwischenböden und Trommelscheiben). C. Neugebohrn. Mathematical. Ills. Serial. 1st part. 4000 w. Zeitschr f d Gesamte Turbinenwesen—Sept. 10, 1910. No. 18057 D.

Turbine Governing.

A Dynamic Study of a Turbine Governor (Etude dynamique avec Essais de Contrôle d'un Appareil de Réglage pour Turbines). Alfred Barbezat. A mathematical discussion with report of tests. Ills. 4000 w. Schweiz Bau—Sept. 3, 1910. No. 18055 B.

Turbines.

Bergmann Steam Turbines. Illustrated description of a turbine of the pure action type, giving a summary of advantages claimed. 2000 w. Prac Engr—Oct. 14, 1910. No. 18159 A.

Horizontal Steam Turbines of Moderate Output. Frank C. Perkins. Illustrates and describes turbines of various types that have been utilized to advantage. 1200 w. Min Wld—Oct. 1, 1910. No. 17623.

Valves.

The Zeuner Valve Diagram. W. J. Harden. An explanation of this diagram, which offers a simple means of studying the relative positions of the valve and main crank during one revolution of the engine. 1300 w. Power—Oct. 11, 1910. No. 17790.

Water Hammer.

Water-Hammer Action in Steam Boilers. Discusses the conditions for the development of water-hammer action, the nature of the disturbance, precautions for its avoidance, etc. 5000 w. Locomotive—July 25, 1910. No. 17784.

TRANSPORTING AND CONVEYING.

Cableways.

Utah Consolidated Aerial Tramway. Leroy A. Palmer. Illustrates and describes a method of transporting economically a large tonnage of ore in a rough region. 2000 w. Mines & Min—Oct., 1910. No. 17615 C.

Conveyors.

Conveyors. Henry J. Edsall. Illustrates and describes appliances for transporting materials and merchandise. 5000 w. Cassier's Mag—Oct., 1910. No. 17697 B.

Cranes.

The Various Types of Gantry Cranes (Die verschiedenen Arten der Verlade-Bockkrane—Verladebrücken). F. Wintermeyer. A review of the various types of travelling gantries adapted to the unloading of ships and similar purposes. Ills. Serial. 1st part. 2000 w. Elektrotech Rundschau—Sept. 29, 1910. No. 18078 D.

MISCELLANY.

Aeronautics.

The Atmospheric Ocean. Prof. A. Lawrence Rotch. Considers some general characteristics of the atmosphere, and illustrates and describes the methods of investigation as carried out at Blue Hill, near Boston. 2000 w. Sci Am—Oct. 22, 1910. No. 18109.

The Practice and Theory of Aviation. Grover Cleveland Loening. Illustrates and describes in detail the fourteen most prominent types of aeroplanes, including seven biplanes and seven monoplanes. 3000 w. Sci Am Sup—Oct. 22, 1910. No. 18111.

Flight at High Altitudes. Marius C. Krarup. Translation and review of an article by Henry Petit considering effects of altitude on motor and aeroplane functions. 2500 w. Automobile—Oct. 6, 1910. No. 17736.

Historical—The Development of the Man-Carrying, Motor-Driven Aeroplane. An illustrated review from the Lilienthal glider of 1895 to the Wright biplane of 1903. 2500 w. Sci Am—Oct. 22, 1910. No. 18104.

The Structural Design of Aeroplanes. Herbert Chatley. A discussion of the general form of the frame and the stresses. General discussion follows.

7500 w. Trans Inst of Civ Engrs of Ireland—Vol. XXXVI. 1910. No. 18219 N.

The Racing Aeroplane of the Future—A Study. J. Bernard Walker. A prediction of the leading characteristics based on a study of the trend of development. 1600 w. Sci Am—Oct. 22, 1910. No. 18106.

Leading French and American Aeroplanes, Their Construction and Methods of Control. Illustrated description of leading types and their methods of operation. 1500 w. Sci Am—Oct. 22, 1910. No. 18105.

The Regnard Aeroplane. Paul F. Mottelay. Illustrates and describes apparatus for securing the automatic stability of flying machines by means of the gyroscope. 1200 w. Sci Am Sup—Oct. 8, 1910. No. 17725.

Tests of Aeroplane Propellers. R. E. Dudley and Arthur Steed. A thesis presented at Univ. of Missouri. A report of laboratory tests on air propellers at various pitches at various speeds. 2000 w. Am Mach—Vol. 33. No. 43. No. 18187.

Aerial Propellers and Some Test Results. Charles Edward Larard and Robert Oliphant Boswall. Slightly abridged from *Engineering*. An illustrated report of experimental work and results. 2500 w. Jour Fr Inst—Oct., 1910. No. 17937 D.

Air Craft in War. An illustrated discussion of the possibilities of aeroplanes and dirigibles. 1500 w. Sci Am—Oct. 22, 1910. No. 18107.

The Aeroplane in War. Describes practical tests made of the military airship and aeroplane at the French military manoeuvers of 1910. 3500 w. Sci Am Sup—Oct. 15, 1910. No. 17845.

Learning to Fly on French Aerodromes. W. F. Bradley. An illustrated account of present methods of instruction. 1500 w. Sci Am—Oct. 22, 1910. No. 18108.

The First Crossing of the Alps in an Aeroplane. An illustrated account of the crossing by George Chaviz, made on Sept. 23, 1910. 2000 w. Sci Am Sup—Oct. 22, 1910. No. 18110.

Story of the Wellman Ocean Air Trip. Illustrated account of the trip, by Mr. Vaniman. 1800 w. Sci Am—Oct. 29, 1910. No. 18235.

"Clement-Bayard II." Carl Dienstbach. Illustrated description of the French military dirigible airship which took part in the French manoeuvers. 1500 w. Sci Am—Oct. 8, 1910. No. 17723.

The Dirigible "Clement-Bayard II" (Le Dirigeable "Clément-Bayard II"). A. Riester-Picard. Describes the winner in the French War Office trials. Ills. 1800 w. Génie Civil—Sept. 17, 1910. No. 18019 D.

See also Units, under MEASUREMENT.

Curtain Rollers.

Gravity Self-Raising Rollers for Maps, Theatre Curtains, Etc. R. W. Weekes. Read before the Engng. Sec. of the British Assn., at Sheffield. A detailed description of a gravity system of suspending, explaining its advantages. 800 w. Engng—Oct. 14, 1910. No. 18166 A.

Textile Machinery.

Textile Machinery at the Brussels Exposition (Die Arbeitsmaschinen für die Textilindustrie auf der Weltausstellung in Brüssel 1910). G. Rohn. Detailed description of the exhibits. Ills. Serial. 1st part. 5000 w. Zeitschr d Ver Deutscher Ing—Sept. 10, 1910. No. 18097 D.

Watch Jewels.

Manufacturing Jewels for Watches. F. A. Stanley. Illustrates and describes how the stones are held, lapped down, chipped, turned, drilled and finished at a remarkable rate of speed. 2500 w. Am Mach—Vol. 33. No. 41. No. 17878.

Weighing Machines.

Weighing Materials Automatically. Illustrated descriptions of accurate mechanical devices for this work. 3500 w. Am Mach—Vol. 33. No. 40. No. 17708.

MINING AND METALLURGY.

COAL AND COKE.

Anthracite.

Anthracite. Considers true anthracite, "ash content" of anthracite, metamorphic anthracite, and the heat theory of formation. 1800 w. Col Guard—Oct. 7, 1910. No. 17908 A.

Coke Ovens.

Koppers By-Product Coke Ovens. W. E. Hartman. Illustrated description of a process by which ammonium sulphate is made directly from the gas. 2400 w. Mines & Min—Oct., 1910. No. 17621 C.

Coking.

Mining, Preparing, and Coking Coal. Illustrates and describes the plant and methods used at Marting, W. Va. 3000 w. Mines & Min—Oct., 1910. No. 17618 C.

Conservation.

Conservation as it Affects Coal Lands. E. W. Parker. Read before the Am. Min. Cong. Discusses conditions and methods responsible for waste. 2000 w. Min & Sci Pr—Oct. 8, 1910. No. 17848.

Electric Power.

Electric Shocks in Coal Mines. Sydney F. Walker. A review of actual and unusual cases where fatal results have followed careless handling of charged apparatus. 7000 w. Eng & Min Jour—Oct. 8, 1910. No. 17782.

Explosions.

Protective Value of Humidity. James Ashworth. Discusses whether moisture has any protective value on the progress of explosions, deciding in the negative. 2500 w. Mines & Min—Oct., 1910. No. 17622 C.

Some Causes and Prevention of Colliery Explosions. George H. Winstanley. A lecture before the Nat'. Assn. of Colliery Mgrs. Explains the term explosion, and discusses the dangers causing such disasters in coal mines. 7000 w. Ir & Coal Trds Rev—Sept. 30, 1910. No. 17820 A.

Germany.

Coal Mines Operated by Ironworks in the Ruhr District, Germany (Die Hüttenzechenfrage im Ruhrbezirk). Herr Pilz. Discusses in great detail their effect on the German coke industry. Serial. 1st part. 18000 w. Glückauf—Sept. 17, 1910. No. 18048 D.

Indiana.

Mining Coal in Southern Indiana. Floyd W. Parsons. Information concerning methods employed, cost of mining, and explosives. Ills. 1000 w. Eng & Min Jour—Oct. 29, 1910. No. 18242.

Mine Dust.

The Explosibility of Coal Dust. George S. Rice. With chapters by J. C. W. Frazer, Oxel Larsen, Frank Haas, and Carl Scholz. States the problem and gives a review of the question in Europe and the United States, reporting experimental studies, and related matters of interest. Ills. 6500 w. U. S. Geol Surv—Bul. 425. No. 17985 N.

Mining.

Division of Labor in Bituminous Coal Mining. W. E. Fohl. A plan for eliminating the factors of inefficiency in the processes of coal production. 2500 w. Engineering Magazine—Nov., 1910. No. 18252 B.

Mining Plants.

A Mining Power Plant. Illustrated description of the Hampton Electric power plant of the D., L. & W. Ry. Co. at Scranton, Pa. 2000 w. Elec Rev, N Y—Oct. 1, 1910. No. 17600.

Montana.

Stratigraphic Relations of the Livingston Formation of Montana. R. W. Stone and W. R. Calvert. Gives results of field study, showing the coal-bearing formation of the Livingston section is not Laramie, and giving information of geologic interest. Map. 2200 w. Ec-Geol—Sept., 1910. No. 17934 D.

Peat.

The Production of Peat. L. B. Lincoln. Illustrates and describes a new automatic movable peat plant based on the wet machine process. 1200 w. Heat & Vent Mag—Oct., 1910. No. 18130.

Rescue Apparatus.

A Comparison of the Earlier Dräger Apparatus with the 1910 Model (Vergleich der ältern Dräger-Apparate mit dem neuen Modell 1910). Fritz Jüngst. A comparison of the structure and efficiency of the apparatus. Ills. 4500 w. Glückauf—Sept. 10, 1910. No. 18046 D.

Rescue Stations.

The Progress of Rescue Stations in British Coal Mines. T. Lington. Information concerning what is being done toward establishing such stations at collieries. 1500 w. Min Wld—Oct. 1, 1910. No. 17626.

Notes on Rescue Training. Read before the Nat. Assn. of Col. Mgrs. Part of a paper by T. T. Mawson. Describes the principal features of the Howe Bridge station and the training of the rescue brigade. 4500 w. Ir & Coal Trds Rev—Sept. 23, 1910. No. 17685 A.

Safety Lamps.

New Acetylene Safety Lamps. Bergassessor Beyling, in *Glückauf*. Illustrates and describes the Wolf, the Seippel, and the Koch designs. 1500 w. Ir & Coal Trds Rev—Sept. 23, 1910. No. 17684 A.

Wales.

The Submarine Area of Coal Measures in Swansea Bay. Henry K. Jordan. From a paper read before the S. Wales Inst. of Engrs. Map showing conjectured area, with remarks on the probable extent and thickness of the coal measures. 2000 w. Ir & Coal Trds Rev—Oct. 14, 1910. No. 18175 A.

Washing.

The Sizing, Sorting and Washing of Coal. W. Bardill. Deals with the processes in use at the present time and the departures likely to appear in the near future. 6000 w. Ir & Coal Trds Rev—Oct. 7, 1910. No. 17916 A.

COPPER.

Arizona.

See Prospecting, under MINING.

Assaying.

Analytical Methods in the Cananea Laboratory. F. G. Hawley. Explains the methods of routine chemical analysis used. 5500 w. Eng & Min Jour—Oct. 1, 1910. No. 17602.

The Color and Cyanide Methods for Copper. Arthur Austin. Abstract from *Western Chemist and Metallurgist*, of a paper giving résumé of practice at a large western smeltery, with abstracts from articles relative to the colorimetric and cyanide copper determinations. 4000 w. Min Wld—Oct. 22, 1910. No. 18125.

Chile.

The Collahuasi Copper District, Chile. Robert Hawxhurst. Map, history and general description of the district, its geology, ore deposits, and mining properties. 3500 w. Min Mag—Oct., 1910. No. 18212 B.

Mexico.

A Geological Journey in Guerrero. John Wellington Finch. A geological discussion of the district, especially considering the Reforma Mine, Campo Morado, Mexico. Ills. 3500 w. Min & Sci Pr—Oct. 15, 1910. No. 17996.

Peru.

Mining in Quiruvilca, Province of Santiago de Chuco, Peru. F. Malaga Santolalla. Information concerning the geology and mineral deposits, and the Elvira mine. 1200 w. Min Jour—Oct. 1, 1910. No. 17827 A.

Refining.

Electrolytic Copper Refining in Australia. G. H. Blakemore. Abstract of paper before the Australian Inst. of Min. Engrs. Describes plant and methods in use at Lithgow, N. S. W. Ills. 4000 w. Eng & Min Jour—Oct. 8, 1910. Serial. 1st part. No. 17781.

Smelting.

Mining and Smelting in Aguascalientes. Bruno Newman. Brief description, with illustration, of the largest custom smelter in America. 1500 w. Eng & Min Jour —Oct. 1, 1910. No. 17610.

GOLD AND SILVER.

Assaying.

Assay of Arsenical Nickel Cobalt Silver Ore. Denison K. Bullens. Information concerning the sampling and assaying of Cobalt silver ore. 2000 w. Eng & Min Jour—Oct. 22, 1910. No. 18101.

Brazil.

Notes on Passagem Mine and Works. Arthur J. Bensusan. Describes the geological and mineralogical features of this gold mine in Minas Geraes, Brazil, method of mining, etc. 8800 w. Inst of Min & Met, Bul. 73—Oct. 15, 1910.

British Columbia.

The Bayonne Mining District, British Columbia. Map, showing location, with descriptive notes. 1600 w. Min Wld—Oct. 1, 1910. No. 17627.

Cobalt

The Structure of Silver Deposits of Nipissing. Reginald E. Hore. Detailed description of the ore deposits, the influence of country rock, the geology of the district, etc. Ills. 2500 w. Min Wld—Oct. 22, 1910. No. 18124.

The Timmins - Armstrong - McGibbons Areas. Alex. Gray. An illustrated account giving information of these properties in Canada. 4500 w. Min Wld—Oct. 8, 1910. No. 17797.

Costa Rica.

Mines and Mill of Montezuma Mines, Costa Rica. S. F. Shaw. Illustrated description of veins and their development. 2200 w. Eng & Min Jour—Oct. 8, 1910. No. 17780.

Cyaniding.

Present Tendencies in Cyanide Practice. Mark R. Lamb. Reviews record developments at different plants. 5000 w. Eng & Min Jour—Oct. 29, 1910. No. 18240.

Modern Hydrometallurgy in Australia. J. R. Masson and J. E. Edwards. An illustrated account of methods of treatment of gold and silver-bearing ores. 2500 w. Met & Chem Engng—Oct., 1910. No. 17763 C.

The New Clancy Method of Ore Treatment. Relates to novel methods of treating ores bearing the precious metals. 5000 w. Min Wld—Oct. 15, 1910. No. 17884.

Dredging.

Notes on the Construction of California Dredges. John Tyssowski. A report of the tendency in building, and the cost, giving tabulated data on the dredge equipment and power consumption. Plate. 3500 w. Eng & Min Jour—Oct. 15, 1910. No. 17872.

Dredging Conditions on the Seward Peninsula. G. B. Massey, II. Illustrates and describes dredges and their operation in a region noted for the general distribution of gold. 6500 w. Eng & Min Jour—Oct. 29, 1910. No. 18241.

Mexico.

Mineral Resources of the State of Guerrero. William Niven. Illustrated account of important gold-producing properties. 2000 w. Eng & Min Jour—Oct. 1, 1910. No. 17609.

The Arteaga District, Chihuahua. L. T. Pockman. Brief illustrated description. The principal mineral is argentite. 700 w. Eng & Min Jour—Oct. 1, 1910. No. 17605.

Mining Operations in the State of Chihuahua. W. H. Seamon. The mines produce silver, gold, lead, copper, and zinc. There are also large deposits of iron ore. Reports conditions at the various properties being worked. 2500 w. Eng & Min Jour—Oct. 1, 1910. No. 17604.

Yoquivo Mine and Mill, Western Chihuahua. W. H. Seamon. Gives results of two years' development of this silver-gold property. Ills. 1200 w. Eng & Min Jour—Oct. 22, 1910. No. 18102.

San Rafael of Anexas Mining Company, Pachuca. E. Girault. Abstract translation describing the properties and their development. Averages 1,080 grams silver and 4 grams gold to the ton. Profile and section. 3000 w. Eng & Min Jour—Oct. 1, 1910. No. 17601.

See also Placers, under GOLD AND SILVER.

Montana.

History and Geology of the Garnet District, Mont. J. P. Rowe. Illustrates and describes the district and its gold-mining properties, reviewing the early mining history. 5000 w. Min Wld—Oct. 15, 1910. No. 17883.

Nevada.

The Cost of Goldfield Mining Boom. Augustus Locke. Considers especially the more important losses resulting from the boom of this Nevada district, and also some important gains. Ills. 2000 w. Min & Sci Pr—Oct. 22, 1910. No. 18226.

Notes on Operations in Jarbidge Camp, Nevada. Winthrop W. Fisk. Describes deposits of low-grade gold ores, reporting promising showings. Map. 2000 w. Eng & Min Jour—Oct. 15, 1910. No. 17871.

Ontario.

The Porcupine Trail. Reginald E. Hore. An illustrated account of Ontario's newest gold camp. 1500 w. Can Min Jour—Oct. 15, 1910. No. 17960.

The First Rush to the Porcupine Gold Fields. Alex. Gray. Illustrated account of early discoveries and development in this Canadian field. 4000 w. Min Wld—Oct. 1, 1910. No. 17624.

Present Developments at Gowganda. G. M. Colvocoresses. Explains conditions at this silver camp and gives illustrated detailed descriptions of some of the mines. 3000 w. Can Min Jour—Oct. 1, 1910. No. 17703.

The Quartz Diabases of Nipissing District, Ontario. W. H. Collins. Discusses the petrology of these bodies, and attempt to determine their relations to the silver-cobalt ore deposits. 4200 w. Ec-Geol—Sept., 1910. No. 17933 D.

Placers.

The Altar Gold Placer Fields of Sonora, Mexico. Illustrates and describes the country and mining methods employed. 2500 w. Eng & Min Jour—Oct. 1, 1910. No. 17603.

Silver.

The Solubility of Oxygen in Molten Silver. F. G. Donnan and T. W. A. Shaw. Abstract of paper read before the Soc. of Chem. Ind. Describes investigations. 2500 w. Min Wld—Oct. 8, 1910. No. 17798.

IRON AND STEEL.

Blast-Furnace Gas.

The Purification of Blast Furnace Gas in Germany. Curt Grosse. From a paper before the Dusseldorf Congress. Illustrates and describes appliances in use. 2500 w. Ir & Coal Trds Rev—Oct. 14, 1910. No. 18176 A.

Blowers.

New Turbo-Blower Driven by Exhaust Steam at the Works of Altos Hornos de Vizcaya. Illustrated description of a Rateau mixed-pressure turbo-blowing plant, with accumulator and Le Blanc condenser. 1400 w. Ir & Coal Trds Rev—Sept. 30, 1910. No. 17819 A.

Electrometallurgy.

Recent Advances in the Construction of Electric Furnaces for the Production of Pig Iron, Steel, and Zinc. Eugene Haanel. Introductory remarks on the present status of the electric steel industry, with list of electric steel furnaces in Europe, etc.; information concerning iron and smelting furnaces, and for the reduction of steel and zinc oxide, and other related subjects. Ills. 20000 w. Can Dept of Mines—No. 68. No. 17980 N.

See also Ferro-Alloys, Steel Refining, and Steel Works, under IRON AND STEEL; and Refractory Materials, under MISCELLANY.

Expositions

Iron and Steel at the Brussels Exposition (Das Eisenhüttenwesen auf der Brüsseler Weltausstellung 1910). Reviews the exhibits by countries. Ills. 7000 w. Stahl u Eisen—Sept. 21, 1910. No. 18039 D.

Ferro-Alloys.

Electrometallurgy of Ferro-Alloys and Steel. Paul Girod. Abstract of paper read before the Faraday Soc. A short description of the principal alloys made by the use of the Girod furnace. 1200 w. Elect'n, Lond—Oct. 14, 1910. No. 18155 A.

Industry.

Co-operation in the Iron and Steel Industry; Presidential Address Before the American Iron and Steel Institute. Elbert H. Gary. An important address, advocating co-operation. Also editorial. 4000 w. Eng News—Oct. 20, 1910. No. 17957.

Mexico.

Iron Resources of the Republic of Mexico. Ezequiel Ordonez. A report of deposits and their character. 2500 w. Eng & Min Jour—Oct. 1, 1910. No. 17608.

Minnesota.

Minnesota's Great Iron Mining Industry. W. W. J. Croze. Paper prepared for the Conservation Congress at St. Paul. Map, illustrations and information concerning the producing ranges, transportation, etc. 2500 w. Min Wld—Oct. 15, 1910. No. 17885.

Ontario.

The Occurrence and Origin of Some Bog Iron Deposits in the District of Thunder Bay, Ontario. Elwood J. Moore. A discussion of the factors bearing upon the nature of the occurrence and origin of the iron. 3300 w. Ec-Geol—Sept., 1910. No. 17932 D.

Rolling Mills.

Power Required for Rolling Steel. J. A. Knesche. Second of two articles giving tabulation, analysis, and discussion of test data. 6000 w. Engineering Magazine—Nov., 1910. No. 18257 B.

Further Researches on the Power Requirements of Rolling Mills (Weitere Versuche zur Ermittelung des Kraftbedarfes an Walzwerken). An abstract of J. Puppe's report of the work of the Commission appointed by the Verein Deutscher Eisenhüttenleute. Ills. 3000 w. Stahl u Eisen—Sept. 21, 1910. No. 18038 D.

The Utilization of Electric Power in the Iron and Steel Industry; With Special Reference to the Economical Speed Regulation of the Motors. J. J. Elink Schuurman. Read before the Iron & Steel Inst. Discusses economical speed regulation, describing the Scherbius, the Krämer, and the Déri systems and their applications. Ills. 6000 w. Ir & Coal Trds Rev—Sept. 30, 1910. No. 17816 A.

The Manufacture of Rolled "H"-Beams. George E. Moore. Read before the Iron & Steel Inst. Illustrates and describes a few characteristic types of machines, with critical remarks and suggestions. 5500 w. Ir & Coal Trds Rev—Sept. 30, 1910. No. 17815 A.

The Inland Steel Company's Works. Illustrated detailed description of the Indiana Harbor Sheet Mills. 3500 w. Ir Age —Oct. 20, 1910. No. 17994.

Steel Refining.

Electric Steel Refining. D. F. Campbell. Read before the Iron & Steel Inst. Discusses the general aspects of the subject and the probable and possible developments in England. 3000 w. Ir & Coal Trds Rev—Sept. 30, 1910. No. 17808 A.

Steel Works.

The Passing of Crucible Steel. Joseph W. Richards. Illustrates and describes the general plan of the works at Remscheid-Hasten, in Germany, giving a detailed description of the electric furnace work. 3000 w. Met & Chem Engng—Oct., 1910. No. 17758 C.

The Hanyang Iron and Steel Works. George Chamier. Read before the Iron & Steel Inst. Brief illustrated description of these works in China, and the circumstances that have contributed to their marked success. 1200 w. Ir & Coal Trds Rev—Sept. 30, 1910. No. 17809 A.

LEAD AND ZINC.

Lead Smelting.

See Smelting, under COPPER.

Mexico.

Mining and Smelting at Achotta Mine, Guerrero. W. B. Devereux, Jr. Illustrated description of this mining and smelting plant. Only oxidized silver lead ores are smelted at present. 1200 w. Eng & Min Jour—Oct. 1, 1910. No. 17607.

Missouri.

Economic Conditions in the Joplin District. T. Lane Carter. An illustrated article giving a favorable report. 2200 w. Eng & Min Jour—Oct. 15, 1910. No. 17870.

Zinc Smelting.

See Electrometallurgy, under IRON AND STEEL.

MINOR MINERALS.

Aluminium.

The Manufacture of Aluminium Powder (Fabrication de la Poudre d'Aluminium). M. Delastre. Reviews past and present practice in France, referring particularly to the dangers and their prevention. Ills. 2500 w. Rev d'Econ Indus—Sept., 1910. No. 18001 D.

Diamonds.

Blast-Furnace Diamonds and the Diamond Problem (Hochofendiamanten und das Diamantenproblem). Hans Fleissner. A discussion of the problem of making diamonds artificially. Ills. Serial. 1st part. 2000 w. Oest Zeitschr f d Berg u Hüttenwesen—Sept. 17, 1910. No. 18045 D.

Marble.

Australian Marble Industry. Description of rich deposits in Victoria. 3000 w. Aust Min Stand—Sept. 14, 1910. No. 18141 B.

Natural Gas.

The Kent Gas Field. G. R. Mickle. Describes this oil field of Ontario and gives information relating to it. 2500 w. Can Min Jour—Oct. 15, 1910. No. 17961.

Oil.

A Proposed Classification of Petroleum and Natural Gas Fields Based on Structure. Frederick G. Clapp. A brief account of the "anti-clinal theory," its history and application, considering its limitations, and a statement of the structural theory, with a classification showing that accumulations can be grouped into classes. Ills. 4500 w. Ec-Geol—Sept., 1910. No. 17931 D.

Oil in Mexico. Sydney A. R. Skertchly. Remarks on local conditions that govern the oil business in Mexico. Map and Ills. 2200 w. Min Mag—Oct., 1910. No. 18213 B.

Radioactive Minerals.

A New Radio-Active Mineral in Western Australia. E. S. Simpson. Read before the Nat. Hist. & Sci. Soc. of W. Australia. Information concerning "Pilbarite," a new mineral from the Pilbarra goldfields. 2000 w. Aust Min Stand—Sept. 7, 1910. No. 17888 B.

Radium.

Notes on Radium Research. J. H. Niemann. Considers reasons for considering radium the cause of the amethyst coloration of crystal glass. 1000 w. Aust Min Stand—Sept. 21, 1910. No. 18142 B.

Tin.

See Prospecting, under MINING.

Tungsten.

Moose River Tungsten Deposits, Nova Scotia. E. R. Faribault. Abstract of a paper read before the Min. Soc. of Nova Scotia. Describes the deposits and states conclusions from their study. 2000 w. Min Wld—Oct. 8, 1910. No. 17796.

MINING.

Accidents.

Mine Accidents and the Bureau of Mines. George S. Rice. Read before the Am. Min. Cong. Information concerning the high accident rate and the work of the Bureau of Mines. 2500 w. Min. & Sci Pr—Oct. 8, 1910. No. 17849.

See also Law, under MINING.

Drainage.

Peculiar Water Problem at Candelaria Mines. George A. Laird. Explains the conditions which make necessary the draining of saturated bodies of soft ore surrounded by country rock. Describes methods used. 2000 w. Eng & Min Jour —Oct. 1, 1910. No. 17606.

Drills.

A Comparative Study of Hydraulic and Compressed-Air Drills (Le Perforatrici idrauliche e ad Aria Compressa). S. Gilardi. Gives data obtained in the driving of the Simplon tunnel. Ills. 6000 w. Ing Ferro—Sept. 1, 1910. No. 18030 D.

Electric Power.

Examination for Certificate of Competency as Mine Electrician in New South Wales. Gives lists of questions set for candidates at the examinations held at the technical colleges. 1500 w. Ir & Coal Trds Rev—Oct. 7, 1910. No. 17919 A.

Electrical Mining Notes. Sidney F. Walker. Considers causes of accidents, believing the troubles due to absence of care or poor insulation, and discusses applications. 4000 w. Elec Rev, N Y—Oct. 8, 1910. No. 17778.

Explosives.

The Proper Detonation of High Explosives. Charles S. Hurter. Abstract of a paper read before the L. Superior Min. Inst. Classifies explosives, and discusses in detail the subject of detonation. 5500 w. Min Wld—Oct. 22, 1910. No. 18127.

Haulage.

Electric Haulage in Collieries and Mines. Illustrates and describes types of rope haulage gears driven by electric motors. 3000 w. Elec Rev, Lond—Sept. 30, 1910. No. 17821 A.

Electric Haulage in Mines. Arthur Hall. Read at Nat. Assn. of Col. Mgrs. Especially discusses the efficiency, economy and speed. Ills. 4500 w. Ir & Coal Trds Rev—Oct. 7, 1910. No. 17920 A.

Transport of Coal and Ore by Electric Traction. W. C. Brown. Read before the S. African Inst. of Elec. Engrs. Discusses types of motors, weight of rails, and other matters affecting the success. 4500 w. Elec Engr, Lond—Sept. 23, 1910. No. 17673 A.

Underground Haulage in German Mines. F. Tillmann. Abstract translation of paper read at the Dusseldorf Cong. Describes various systems of haulage in German mines, giving particulars of the relative cost. 2000 w. Ir & Coal Trds Rev—Oct. 7, 1910. No. 17915 A.

Hoisting.

The Evolution of Hoisting. Describes ancient methods showing the ideas from which modern machines have been derived. Ills. 4200 w. Mines & Min—Oct., 1910. Serial. 1st part. No. 17616 C.

The Safety of Hoisting Ropes (Seilsicherheit bei der Schachtförderung). F. Baumann. Discusses the method of calculating the size of rope to be used for a given service. 4000 w. Glückauf—Sept. 24, 1910. No. 18050 D.

Hoisting Engines.

Experiments with Steam and Electric Winding Engines. Trans. from *Glückauf.* Gives tabulated information based on experiments on the consumption of power in winding engines, with a view to establishing comparative data for the various structural types of engine. 1000 w. Col Guard—Sept. 30, 1910. No. 17830 A.

Labor.

The Efficiency of Labor Underground. Tom Johnson. Outlines a scheme for increasing the efficiency of the men. 2500 w. Jour Chem, Met, & Min Soc of S Africa—Aug., 1910. No. 17886 E.

Law.

Report of Committee on Uniform Mining Laws for Prevention of Mine Accidents. 14000 w. Bul Am Inst of Min Engrs—Oct., 1910. No. 18132 F.

Mine Buildings.

Fireproof Buildings for Mining Companies. Ernest McCullough. Describes the construction of a new character of building which costs little more than wood-frame structures, and has many advantages. Ills. 2000 w. Min Wld—Oct. 8, 1910. No. 17795.

Mine Development.

Notes for the Mining Public Concerning Certain Mistaken Ideas. F. Danvers Power. Read before the Aust. Inst. of Min. Engrs. A general discussion of mine development and matters related. 6500 w. Queens Gov Min Jour—Sept. 15, 1910. No. 18140 B.

Prospecting.

Prospecting for Tin in Siam. G. B. Adeney. Describes the indications which lead the prospector, the methods employed in proving the value of the ground, and the results. Map. 1500 w. Min Mag—Oct., 1910. No. 18214 B.

Prospecting with Churn Drills at Miami, Ariz. H. A. Fuld. Gives data taken from the drill log of one of the copper companies concerning the drilling, economic conditions, etc. 1200 w. Eng & Min Jour —Oct. 22, 1910. No. 18100.

Pumping.

Pumping at Bisbee, Arizona. C. C. Austin. Illustrates and describes the plant at the Junction shaft of the Superior and Pittsburg Copper Co. 2000 w. Mines & Min—Oct., 1910. No. 17612 C.

Shafts.

Elliptical vs. Rectangular Shafts. William Archie Weldin. Presents some advantages of rectangular over elliptical forms for concrete-lined shafts. Ills. 3000 w. Mines & Min—Oct., 1910. No. 17617 C.

Method and Cost of Lining a Mine Shaft with Concrete. R. H. Worcester. Illustrated detailed description of the work, with itemized costs. 4000 w. Engng-Con—Oct. 26, 1910. No. 18188.

Shaft Sinking.

Deep Excavation by Boring. J. F. Springer. Briefly outlines excavation methods used for various depths and conditions, and illustrates and describes the well-boring process of sinking shafts. 1800 w. Sci Am—Oct. 15, 1910. No. 17844.

See also Boring, under CIVIL ENGINEERING, Construction.

Stowing.

The Stowing Plant at Shafts I-VI of the Consolidation Mine (Die Spülversatzeinrichtungen auf der Schachtanlage I-VI der Zeche Consolidation). Herr Schäfer. Detailed description of the method of stowing this German mine. Ills. 4000 w. Glückauf—Sept. 10, 1910. No. 18047 D.

Timbering.

The Timbering Rule. Explains the aspects of the rule that may create doubt as to its real meaning. 700 w. Col Guard—Oct. 7, 1910. No. 17907 A.

Timbering in the Joplin District. Lucius L. Wittich. Describes conditions requiring large quantities of timber, and the method of placing. Ills. 2500 w. Mines & Min—Oct., 1910. No. 17614 C.

Ventilation.

The Coefficient of Friction. William Clifford. Discusses the difficulty of calculating the necessary pressure by estimating the rubbing surface, and contends that each mine has its own particular coefficient. 2500 w. Mines & Min—Oct., 1910. No. 17619 C.

Ventilation and Health Conditions on the Mines of the Witwatersrand, with Special Reference to the Ventilation System of the East Rand Proprietary Mines. S. Penlerick. Considers means to remove the causes of disease among miners, giving illustrated description of a system of forced ventilation. Discussion. 10000 w. Jour Chem, Met, & Min Soc of S Africa—Aug., 1910. No. 17887 E.

ORE-DRESSING AND CONCENTRATION.

Briquetting.

The Briquetting of Iron Ores. Chevalier C. DeSchwarz. Read before the Iron & Steel Inst. States conditions for successful briquetting and considers systems in which a binding medium is used, and systems without a binding medium. 5500 w. Ir & Coal Trds Rev—Sept. 30, 1910. No. 17817 A.

Agglomerating Ore Fines and Flue Dust. Herbert Haas. Explains causes of the production of flue dust and gives an illustrated description of the Haas process of sintering ore fines. 3500 w. Eng & Min Jour—Oct. 22, 1910. No. 18103.

Electrostatic Separation.

Use of Static Electricity in the Separation of Mineral Particles. Henry A. Wentworth. An illustrated description of an electrostatic separating mill, with information relating to its use. 1800 w. Elec Wld—Oct. 6, 1910. No. 17711.

Gold Milling.

Treatment of Refractory Low-Grade Gold Ores at the Ouro Preto Gold Mine, Brazil. R. H. Kendall. Deals with modifications and improvements effected by the author during his stay at the mine. 10800 w. Inst of Min & Met, Bul. 73—Oct. 15, 1910. No. 18134 N.

Ore-Reduction Plant at City Deep Mines, Ltd. Rowland Gascoyne. Illustrated description of a plant on the Witwatersrand, designed to treat 65000 tons of ore per month, driven by electricity. 1800 w. Min Wld—Oct. 22, 1910. No. 18126.

Iron.

New Plant for Washing Iron Ore, Mesabi Range. E. K. Soper. Plans and description of the Oliver washery at Coleraine, Minn., in which log-washers and Overstrom tables are used. 2000 w. Eng & Min Jour—Oct. 8, 1910. No. 17779.

Zinc Milling.

Zinc Ore Dressing in Colorado. H. C. Parmelee. Describes the property and methods of the Marion Mines and Mill Co., at Fairview, Colo. 2000 w. Met & Chem Engng—Oct., 1910. Serial. 1st part. No. 17759 C.

MISCELLANY.

Analyses.

Report of Analyses of Ores, Non-Metallic Minerals, Fuels, Etc. Made in the Chemical Laboratories During the years 1906, 1907, 1908. Arranged by F. G. Wait. 2 plates. 20000 w. Can Dept of Mines—No. 59. No. 17981 N.

Asia Minor.

The Mineral Resources of Asia Minor. A résumé of the principal mineral deposits of Turkey in Asia. 2800 w. Min Jour—Oct. 15, 1910. No. 18161 A.

Canada.

The Mineral Industries of Canada. H. Mortimer-Lamb. Read before the Int. Congress at Dusseldorf. Reports recent progress of the mining industries, and presents a survey of conditions in the hope that the information will lead to a study of the mineral area. Ills. 22500 w. Sec. IV. Paper 15. No. 18217 N.

Ore Deposits.

Surface Indications of Ore-Shoots in Depth. William H. Storms. Gives facts from the writer's observation and experience concerning the topographical conditions which may be considered to indicate ore-shoots beneath the surface. 2500 w. Min & Sci Pr—Oct. 22, 1910. No. 18225.

The Agency of Manganese in the Superficial Alteration and Secondary Enrichment of Gold-Deposits in the United States. William H. Emmons. An experimental study, with discussion of results, and review of mining districts. Map. 23000 w. Bul Am Inst of Min Engrs—Oct., 1910. No. 18131 F.

Philippines.

The Mineral Resources of the Philippine Islands, with a Statement of the Production of Commercial Mineral Products During the Year 1909. Papers by various writers giving information concerning the metallic and non-metallic ore deposits, the geology, and related subjects. Maps and illustrations. 26500 w. Philippine Bureau of Science—1910. No. 17836 N.

Refractory Materials.

Refractory Materials for Electric Furnaces (Widerstandsmaterial für elektrische Oefen). W. Schuen. A review of various materials used for lining electric furnaces. Ills. Serial. 1st part. 2000 w. Elektrochem Zeitschr—Sept., 1910. No. 18033 D.

Taxation.

System of Taxing Mining Properties in Colorado. A. G. Brownlee. Read before the Am. Min. Cong. A critical discussion of the existing law and its interpretations. 1500 w. Min Wld—Oct. 1, 1910. No. 17625.

RAILWAY ENGINEERING.

CONDUCTING TRANSPORTATION.

Accidents.

The Roscrea Collision. Gives conclusions of Col. von Donop's report on the collision in Ireland on July 19th. Also editorial. 5000 w. Engr, Lond—Sept. 23, 1910. No. 17683 A.

Signaling.

Railway Signaling. C. L. Hacket. Read before the Cent. Ry. & Engng. Club of Canada. Brief discussion of interlocking, block signals, and miscellaneous signals, and the principles on which they are based. 3500 w. Can Engr—Oct. 20, 1910. No. 17992.

Note on the Electric Treadles for Locking the Points on the Belgian State Railways. L. Weissenbruch and J. Verdeyen. Describes the appliances and explains the principles of working. Ills. 2800 w. Bul Int Ry Cong—Aug.-Sept.-Oct., 1910. No. 18178 G.

Signaling at the New Grand Central Terminal. Gives plans of the tracks on the upper and lower levels, plans and elevations of the principal signal cabin, and information about the arrangements for the interlocking. Ills. 2 insets. 2000 w. Ry Age Gaz—Oct. 7, 1910. No. 17744.

The New Hydraulic M. D. M. Signal Plant (System Aster) for the Interlocking of Points and Signals at the Paris-Nord Station (Nouvel Autocombinateur M. D. M., Système Aster, pour la Commande par Fluide et l'Enclenchement des Aiguilles et des Signaux mis en Service à la Gare de Paris-Nord). Paul Aumont. Detailed description. Ills. 7000 w. Rev Gen d Chemins de Fer—Sept., 1910. No. 18005 G.

MOTIVE POWER AND EQUIPMENT.

Air Brakes.

Brakes Sticking. Has particular reference to the No. 6 distributing valve with the quick action cap. 2500 w. Ry & Loc Engng—Oct., 1910. No. 17657 C.

Automatic Connectors for Freight and Passenger Train Cars. Willis C. Squire. An illustrated discussion of the subject of automatically connecting up the air brakes between cars, the types, location of connectors, locking devices, etc., with general discussion. 16000 w. Pro W Ry Club—Sept. 20, 1910. No. 17998 C.

Rapidity of Action of Vacuum and Pressure Brakes (Die Durchschlaggeschwindigkeit bei den Luftsauge- und Druckluftbremsen). Karl Kobes. A mathematical study based on the results of the Austrian tests. Ills. 16000 w. Zeitschr d Oest Ing u Arch Ver—Sept. 2, 1910. No. 18064 D.

Car Cleaning.

Unscientific Methods of Coach Cleaning. Wilbur F. Leach. Information concerning the injuries from the use of dopes, soaps, oxalic acid, and ill-advised methods. 1200 w. Ry Age Gaz—Oct. 7, 1910. No. 17746.

Electrification.

The Project for the Electrification of the Austrian State Railways (Bericht über die Vorarbeiten zur Elektrifizierung der K. K. Oesterreichischen Staatsbahnen). Artur Hruschka. A report of the preliminary studies. Ills. Serial. 1st part. 4000 w. Elek Kraft u Bahnen—Sept. 4, 1910. No. 18079 D.

Inauguration of Electric Traction on the Kiruna-Riksgränsen Line of the Swedish State Railways (Einführung des elektrischen Betriebes auf der schwedischen Staatsbahnstrecke Kiruna-Riksgränsen). J. Oefverholm. A brief description of the line and equipment. Ills. 2700 w. Elek Kraft u Bahnen—Sept. 4, 1910. No. 18080 D.

Freight Cars.

High-Capacity Self-Discharging Wagon. Illustrations with brief description of a double-bogie type built for an Italian lignite works. 200 w. Engng—Oct. 14, 1910. No. 18163 A.

Quick-Dumping Drop-Bottom Steel Cars for Handling Iron Ore on the Michigan Iron Range. Illustrated description of two of the new types of cars, with explanation of the performance of the Summers ore car. 3000 w. Eng News—Oct. 27, 1910. No. 18193.

Locomotive Boilers.

The Power of a Locomotive Boiler. C. Hugh Sumner, in *Engng. Rev.* Traces the relation between the size of the boiler and the power developed by the locomotive. 2000 w. Boiler Maker—Oct., 1910. No. 17752.

Locomotive Design.

British Locomotive Development. R. H. Rogers. Discusses recent changes in locomotive design, the problems confronting the motive power departments, and the methods being employed to solve them. 3500 w. Am Engr & R R Jour—Oct., 1910. No. 17755 C.

Locomotive Injectors.

Repairing, Operating and Caring for Inspirators. M. H. Westbrook. Illustrated description of the Hancock inspirator, with suggestions for its repair. 1200 w. Mach (Ry Ed)—Oct., 1910. No. 17800 C.

Locomotive Performance.

Tests of the Latest P. L. M. Compounds with Four Coupled Axles and Pilot Truck (Essais effectivés avec les dernières Locomotives Compound à quatre Essieux couplés et à Bogie de la Compagnie P. L. M.). M. Vallantin. Gives details of the locomotives, the tests, and the results. Ills. 7500 w. Rev Gen d Chemins de Fer—Sept., 1910. No. 18006 G.

Locomotives.

Powerful Lignite Burner of the Mikado Type. Illustrated description of an engine for the Oregon R. R. & Nav. Co. 900 w. Am Engr & R R Jour—Oct., 1910. No. 17756 C.

Simple 2-8-2 for the Oregon Railroad Navigation Co. Illustrated description of a heavy Mikado type using lignite fuel. 900 w. Ry & Loc Engng—Oct., 1910. No. 17656 C.

Heavy Pacific Type Locomotives for the Vandalia R. R. Illustrated detailed description of new engines for heavy trains, with record of eight typical runs. 1200 w. Ry & Engng Rev—Oct. 1, 1910. No. 17686.

Pacific Type Locomotive; Central Railroad of Brazil. Illustrates and describes details of the engine and superheater. 500 w. Ry Age Gaz—Oct. 28, 1910. No. 18230.

Locomotive with Water Tube Fire Box. Illustrated description of an engine for the Northern Ry. of France. 700 w. Am Engr & R R Jour—Oct., 1910. No. 17757 C.

British Locomotives in 1909. J. F. Gairns. Illustrated review of their design and work. 9000 w. Bul Int Ry Cong—Aug.-Sept.-Oct., 1910. No. 18179 G.

French and Foreign Locomotives at the Brussels Exposition (Les Locomotives françaises et étrangères à l'Exposition de Bruxelles de 1910). L. Pierre-Guédon. An illustrated review of the exhibits. Serial. 1st part. 4000 w. Génie Civil—Sept. 3, 1910. No. 18017 D.

Locomotive Superheating.

Superheating on London and Northwestern Locomotives. Illustrated description of a design for two engines, the "George V" and "Queen Mary," exactly alike only one is fitted with Schmidt's system of superheating. They are to be tried on exactly similar work. 500 w. Engr, Lond—Oct. 7, 1910. No. 17913 A.

Locomotive Valve Gears.

Design and Graphical Investigation of the Heusinger Valve Gear for Locomotives (Berechnung und graphische Ermittelung der Heusinger-Steuerung für Lokomotiven). S. E. W. Westren-Doll. A detailed study of the gear. Ills. Serial. 1st part. 5300 w. Glasers Ann—Sept. 1, 1910. No. 18061 D.

Passenger Cars.

The Tait Suburban Car. Illustrates and describes cars for the Victorian government railways of Australia. 1000 w. Ry & Loc Engng—Oct., 1910. No. 17654 C.

Refrigeration.

The Chateau Renard Experimental Refrigeration Station (La Station experimentale du Froid de Chateau Renard). E. Lemaire. Describes a plant to investigate the conditions favorable to the transport of perishable freight. Ills. 2100 w. Génie Civil—Sept. 24, 1910. No. 18022 D.

Shops.

Shops of the National Transcontinental Ry. of Canada. Illustrates and describes the shops at St. Boniface, near Winnipeg. 6500 w. Ry Mas Mech—Oct., 1910. No. 17850.

Engine House Kinks. Illustrates and describes methods and devices used at various shops. 3500 w. Ry Age Gaz—Oct. 7, 1910. No. 17747.

Sleeping Cars.

All Steel Pullman Cars. Illustrated description of a design for all steel sleeping, parlor, club and private cars, which permits the use of a standard underframe complete and many other standard parts. The description given applies principally to the sleeping cars. 1500 w. Am Engr & R R Jour—Oct., 1910. No. 17754 C.

Testing Materials.

The Testing Department of a Railroad Company. B. S. Hinckley. Explains the aim of this department, giving some of the forms used to record the work, and explanation of the advantages. General discussion. 15000 w. Pro N Y R R Club—Sept. 16, 1910. No. 17927.

Analysis—Chemical and Otherwise. E. M. Tewkesbury. Briefly reviews the wonderful development of railways, discussing the need of chemical analysis and physical tests in solving problems relating to the materials used, and the present requirements of traffic. General discussion. 14500 w. Pro Cent Ry Club—Sept. 9, 1910. No. 17928 C.

Train Lighting.

The Leitner System of Electric Train Lighting (Système Leitner pour l'Eclairage électrique des Trains). H. Marchand. Detailed description of the apparatus. Ills. 2500 w. L'Elecn—Sept. 17, 1910. No. 18010 D.

Comparative Cost of Train Lighting by Gas and Electricity (Vergleichende Kostenrechnung für Zugbeleuchtung mit Gasglühlicht und Elektrizität). Max Jakob. Presents estimates of first and operating costs for the two systems. Ills. Serial. 1st part. 2400 w. Tech u Wirt—Sept., 1910. No. 18208 D.

NEW PROJECTS.

Germany.

The New Weisenbach-Forbach Line in the Black Forest (Eine neue Schwarzwaldbahn Weisenbach-Forbach). Herr Gaber. Describes a new mountain line in Germany which involved heavy construction work. Ills. Serial. 1st part. 1000 w. Deutsche Bau—Sept. 17, 1910. No. 18053 B.

Western Maryland.

Western Maryland's Trunk Line Extension. An illustrated description of 87 miles of new construction in progress through the Alleghenies, as a part of a new trunk line between the east and west. 6000 w. Mfrs' Rec—Oct. 27, 1910. No. 18180.

PERMANENT WAY AND BUILDINGS.

Ballast Loader.

Car-Traversing Ballast Loader. Illustrated description of a ballast loader designed by E. J. Beard while building the Philippine Rys. 1000 w. Ry Age Gaz—Oct. 21, 1910. No. 17968.

Curves.

How to Run in Transition Curves Without Tables. C. P. Howard. Explanatory notes. 1500 w. Eng News—Oct. 13, 1910. No. 17843.

Rails.

Rail Steel (Ueber Schienenstahl). Pierre Breuil. Abstract of a paper read at the Düsseldorf Congress, discussing American and European rail steel. Ills. 2500 w. Stahl u Eisen—Sept. 14, 1910. No. 18037 D.

Stations.

Report No. 2 on the Question of Large Stations for Russia, Austria, Hungary, Turkey, Roumania, Bulgaria and Servia. A. Kain. Considers arrangement of tracks, mechanical appliances, etc. Ills. 15700 w. Bul Int Ry Cong—Aug-Sept-Oct., 1910. No. 18177 G.

Terminals.

The New York Improvement and Tunnel Extension of the Pennsylvania Railroad. A finely illustrated description of this great engineering work and the terminal station. Plates. 2500 w. Am Archt—Oct. 5, 1910. No. 17699.

Opening of the Pennsylvania Railroad Station, New York. Illustrates and describes the distinctive features of the station, and gives information relating to the tunnels. 1500 w. Mach (Ry Ed)—Oct., 1910. No. 17799 C.

Terminal Conditions in Chicago. An explanation of conditions and the troubles due to them, with suggestions of the committee appointed to investigate the situation. 3500 w. Ry Age Gaz—Oct. 14, 1910. No. 17855.

Ties.

An Economic Comparison of Railway Ties of Different Materials. Neil N. Campbell. Shows methods of comparison and results obtained by their use. 2000 w. Eng News—Sept. 22, 1910. No. 17352.

Track Maintenance.

A Track Lifting and Ballasting Machine. A machine that does the work of jacks and shovelers is described and illustrated. 700 w. Sci Am—Oct. 8, 1910. No. 17722.

TRAFFIC.

Freight Rates.

Mr. McCrea on Railway Finances. Testimony before the Interstate Commerce Commission, Oct. 12, in regard to the necessity for rate advance. 2200 w. Ry Age Gaz—Oct. 21, 1910. No. 17967.

MISCELLANY.

Austria.

Transportation and Traffic in Austria-Hungary. Logan G. M'Pherson. Preliminary report to the Nat. Waterways Com. Reviews what has been done toward improving rivers, constructing canals, steam railways and their control. 3000 w. Ry Age Gaz—Oct. 28, 1910. No. 18231.

Capitalization.

Railway Capital and Capitalization. William Z. Ripley. Explains the use of their terms both in a commercial and economic sense, the value of railway securities, the distinction between gross and net capitalization, etc. 2500 w. Ry Age Gaz—Oct. 21, 1910. Serial. 1st part. No. 17966.

Great Britain.

British Railways: Some Facts and a Few Problems. Prof. W. E. Dalby. Presidential address before the Engng. Soc. of the British Assn. for the Adv. of Science. Presents facts and problems connected with recent developments of railway working. 3000 w. Mech Engr—Sept. 23, 1910. Serial. 1st part. No. 17670 A.

Legislation.

The Mann-Elkins Act. Frank Haigh Dixon. Abstracted from *Qr. Jour. of Economics.* Discusses the provisions of this amended act of the U. S. Congress. 7000 w. Ry Age Gaz—Oct. 14, 1910. No. 17853.

The New Legislation on Secondary Railways in Austria (Das neue Gesetz über Bahnen niederer Ordnung). Gives the text of the act passed by the Reichsrat on Aug. 8, 1910. 6000 w. Mitt d Ver f d Förd d Lokal u Strassenbahnwesens—Sept., 1910. No. 18032 F.

New Zealand.

Interesting Railway Achievements in New Zealand. W. Wilson. Describes methods by which great natural difficulties have been overcome. Ills. 2000 w. Engineering Magazine—Nov., 1910. No. 18253 B.

Palestine.

The Railways of the Holy Land. Harold J. Shepstone. Illustrated description of the lines. 1800 w. Sci Am Sup—Oct. 15, 1910. No. 17846.

United States.

The Railway Owner, Railway Employee and Railway User. Howard Elliott. Extracts from an address at the Montana State Fair. Discusses the need of co-operation for the common benefit. 3000 w. Ry Age Gaz—Oct. 21, 1910. No. 17969.

Wales.

A New Railway in South Wales. Illustrates and describes interesting features and physical difficulties in the construction of the Treforest extension of the Cardiff railway. 2500 w. Engr, Lond—Oct. 14, 1910. No. 18172 A.

STREET AND ELECTRIC RAILWAYS.

Adhesion Railways.

The Bernina Railway (Die Berninabahn). F. Niethammer. Brief description of the Brusio power station, the sub-stations, and the line, a part of which is on the adhesion system. Ills. Serial. 1st part. 3000 w. Elektrotech u Maschinenbau—Sept. 4, 1910. No. 18088 D.

Car Brake Shoes.

Comparative Durability of Brake Shoes and Tyres. J. W. Dawson. Read before the Munic. Tram. Assn. Describes investigations of the wearing effect upon steel tramway tires by brake shoes, stating conclusions. 4500 w. Elec Engr, Lond—Sept. 30, 1910. No. 17805 A.

Car Meters.

Some Practical Results of the Use of Car Meters. M. Battes. Abstract of a report on replies to questions sent out, with summary of progress made in the use of such meters. 3000 w. Elect'n, Lond—Sept. 30, 1910. No. 17824 A.

Results Obtained by the Use of Car Meters on Tramways. G. Bouton. Abstract of a report on the replies received by the Union Intnat. de Tram, et de Chem. de Fer, etc., in response to questions, with conclusions from a study of results. 4000 w. Elect'n, Lond—Oct 7, 1910. No. 17895 A.

Cars.

Single-Phase Interurban Car Equipments of the Rock Island & Southern Railroad. L. G. Riley. Illustrated description of the equipments for passenger cars, express and freight cars, method of motor drive, etc. 2500 w. Elec Jour—Oct., 1910. No. 17976.

Design of Cars for Chicago Street Railways. Information from the second annual report of the Board of Sup. Engrs. of Chicago Traction, about the design of new street cars. 2500 w. Elec Ry Jour—Oct. 29, 1910. No. 18233.

Car Wheels.

See Car Brake Shoes, under STREET AND ELECTRIC RAILWAYS.

Conductor Maintenance.

Brooklyn Line Department—Manufacturing Facilities, Purchasing Standards and Experimental Work. This sixth and concluding article of a series deals with line material manufacture, storage, purchasing and experimental work. Ills. 5000 w. Elec Ry Jour—Nov. 5, 1910. No. 18359.

Controllers.

Hand Operated Unit Switch Control. Karl A. Simmon. Illustrates and describes details of operation, electrical and mechanical details, and explains advantages claimed. 2500 w. Elec Jour—Oct., 1910. No. 17978.

Notes on the Maintenance of Electro-Pneumatic Control. Gives information based on experience. 2200 w. Elec Ry Jour—Nov. 5, 1910. No. 18362.

Elevated Yards.

Elevated Car Storage Yard. The new yard for subway cars under construction in New York City, extending north from West 240th St., is illustrated and described. 1800 w. Eng Rec—Oct. 15, 1910. No. 17868.

Freight Traffic.

Freight Service of the Scioto Valley Traction Company. Illustrated description of the organization, equipment, methods, development and results. 2000 w. Elec Ry Jour—Oct. 22, 1910. No. 17963.

Locomotives.

Mechanical Features of Electric Locomotives. G. M. Easton. A. discussion of the desired characteristics, reliability, etc., and a comparison of details with steam locomotives. 3000 w. Elec Jour—Oct., 1910. No. 17975.

The Parallel-Crank Drive for Electric Locomotives (Das Parallelkurbelgetriebe als Antriebsmittel für elektrische Lokomotiven). Herr Kleinow. A mathematical and kinematic study of the drive. Ills. 2500 w. Elek Kraft u Bahnen—Sept. 4, 1910. No. 18081 D.

Netherlands.

The Utrecht-De Bilt-Zeist Electric Railway (De electrische tramweg Utrecht-De Bilt-Zeist). E. C. W. van Dijk. Brief description of this interurban line in the Netherlands and its equipment. Ills. 4500 w. De Ingenieur—Sept. 3, 1910. No. 18209 D.

New York City.

Rehabilitation of the Second Avenue Railroad, New York. Brief outline of the history of this independent line, with illustrated description of repairs to tracks and equipment, power supply, etc., to maintain efficient service and reduce cost of operation. 2500 w. Elec Ry Jour—Oct. 29, 1910. No. 18232.

Rack Railways.

Mountain Rack Railways and the Jungfrau Ry. (Switzerland). E. L. Corthell. Gives a table showing railway built on the Abt rack-rail system, with details, and describing important changes and progress on the Jungfrau Ry. Ills. 2000 w. Eng News—Oct. 27, 1910. No. 18195.

Railless.

Trackless Electric Roads. A. Heller. Trans. from *Zeit. des Ver. Deut. Eng.* Illustrated review of the present state of the art. 1800 w. Sci Am Sup—Oct. 29, 1910. No. 18237.

Single Phase.

What Frequency Should be Employed for Single-Phase Traction with Regard to the Present and Future Development of the Single-Phase Motor (Welche Periodenzahl sollte mit Rücksicht auf der gegenwärtigen und künftigen Stand der Triebmotorentechnik bei Einphasenwechselstrombahnen Anwendung finden)? Wilhelm Wittek. Advocates further study before abandoning twenty-five cycles. 6000 w. Elektrotech u Maschinenbau—Sept. 18, 1910. No. 18092 D.

Subways.

Construction of a Rapid Transit Railroad in Relation to the Handling of Passengers, as Illustrated by the Hudson and Manhattan Railroad. J. Vipond Davies. States the problems of passenger transportation due to concentration in cities, and describes the solution as adopted by the company named. 8500 w. Pro Engrs' Club of Phila, No. 1091—Oct., 1910. No. 18249 D.

The Letting of Contracts for the Tri-Borough Rapid Transit R. R. in New York City. Editorial on rapid transit underground railway construction in New York City, with record of bids for the construction of the Tri-Borough Ry. 10000 w. Eng News—Nov. 3, 1910. No. 18354.

Motor Trains on Long Island Road. W. B. Kouwenhoven. Describes the car service through the Pennsylvania tunnels under the East River. 2500 w. Ry & Loc Engng—Nov., 1910. No. 18320 C.

Terminals.

Urban and Interurban Terminals. Martin Schreiber and F. F. Low. Abstract of paper forming a part of the report of the committee of buildings and structures of the Am. St. & Int. Ry. Engng. Assn. Ills. 2000 w. Elec Ry Jour—Oct. 15, 1910. No. 17881.

Three-Phase.

Three-Phase Traction in Italy. Warren H. Miller. Illustrated account of practical problems encountered on the three-phase Giovi line. 1800 w. Elec Wld—Oct. 13, 1910. No. 17857.

Ties.

Chemical Treatment of Ties Used in the Chicago Track Rehabilitation. Abstract from report of the Board of Sup. Engrs. of Chicago Traction, on investigations made preliminary to the adoption of the chloride of zinc treatment. 1500 w. Elec Ry Jour—Oct. 29, 1910. No. 18234.

Track Construction.

The Track and Line Construction of Electric Railways. Gives tabulated results of an inquiry as to general practice in track construction, pole and line equipment of interurban electric lines, with a review of the information. 7000 w. Eng News—Oct. 27, 1910. No. 18199.

Track Reconstruction on the Chicago Street Railways. Illustrates and describes types of track, and methods of construction, material, foundation, paving, etc. 7500 w. Eng News—Nov. 3, 1910. No. 18349.

Traffic.

Advertising Methods and Traffic of the Cleveland, Painesville, and Eastern Railroad. E. L. Schmock. An account of methods used on this Ohio line. 2000 w. Elec Ry Jour—Nov. 5, 1910. No. 18360.

Trolley Lines.

Itemized Unit Costs of 98 Special Overhead Layouts for a Trolley Railway. Diagrams. 6000 w. Engng-Con—Oct. 19, 1910. No. 17950.

See Track Construction, under STREET AND ELECTRIC RAILWAYS.

Winnipeg.

Construction and Operating Features of the Winnipeg Electric Railway. Illustrated detailed description of the Winnipeg system and its operation. 4000 w. Elec Ry Jour—July 9, 1910. No. 15421.

EXPLANATORY NOTE—THE ENGINEERING INDEX

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language*, together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cts. The letter A, B, or C denotes a price of 40 cts.; D, of 60 cts.; E, of 80 cts.; F, of $1.00; G, of $1.20; H, of $1.60. When the letter X is used it indicates that copies are not readily obtainable and that particulars as to price will be supplied on application. Certain journals, however, make large extra charges for back numbers. In such cases we may have to increase proportionately the normal charge given in the Index. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

Serial publications are indexed on the appearance of the first instalment.

SPECIAL NOTICE.—To avoid the inconvenience of letter-writing and small remittances, especially from foreign countries, and to cheapen the cost of articles to those who order frequently, we sell coupons at the following prices:—20 cts. each or a book of twelve for $2.00; three books for $5.00.

Each coupon will be received by us in payment for any 20-cent article catalogued in the Index. For articles of a higher price, one of these coupons will be received for each 20 cents; thus, a 40-cent article will require two coupons; a 60-cent article, three coupons; and so on. The use of these coupons is strongly commended to our readers. They not only reduce the cost of articles 25 per cent. (from 20c. to 15c.), but they need only a trial to demonstrate their very great convenience—especially to engineers in foreign countries, or away from libraries and technical club facilities.

Write for a sample coupon—free to any part of the world.

CARD INDEX.—These pages are issued separately from the Magazine, printed on one side of the paper only, and in this form they meet the exact requirements of those who desire to clip the items for card-index purposes. Thus printed they are supplied to regular subscribers of THE ENGINEERING MAGAZINE at 10 cents per month, or $1.00 a year; to non-subscribers, 25 cts. per month, or $3.00 a year.

THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *t-m*, a tri-monthly, *qr*, a quarterly, *s-q*, semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated; W—Words; Anon—Anonymous.

Alliance Industrielle. *m.* Brussels.
American Architect. *w.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Jl. of Science. *m.* New Haven, U. S. A.
American Machinist. *w.* New York.
Anales de la Soc. Cien. Argentina. *m.* Buenos Aires.
Annales des Ponts et Chaussées. *m.* Paris.
Ann. d Soc. Ing. d Arch Ital. *s-m.* Rome.
Architect. *w.* London.
Architectural Record. *m.* New York.
Architectural Review. *s-q.* Boston.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Melbourne.
Autocar. *w.* Coventry, England.
Automobile. *w.* New York.
Automotor Journal. *w.* London.
Beton und Eisen. *qr.* Vienna.
Boiler Maker. *m.* New York.
Brass World. *m.* Bridgeport, Conn.
Brickbuilder. *m.* Boston.
Builder. *w.* London.
Bull. Bur. of Standards. *qr.* Washington.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bull. of Can. Min. Inst. *qr.* Montreal.
Bull. Soc. Int. d'Electriciens. *m.* Paris.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bull. Int. Railway Congress. *m.* Brussels.
Bull. Scien. de l'Assn. des Elèves des Ecoles Spéc. *m.* Liége.
Bull. Tech. de la Suisse Romande. *s-m.* Lausanne.
California Jour. of Tech. *m.* Berkeley, Cal.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *w.* Toronto and Montreal.
Canadian Mining Journal. *b-w.* Toronto.
Cassier's Magazine. *m.* New York and London.
Castings. *m.* Cleveland, O.
Cement. *m.* New York.
Cement Age. *m.* New York.
Central Station. *m.* New York.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Colliery Guardian. *w.* London.
Commercial Vehicle. *m.* New York.

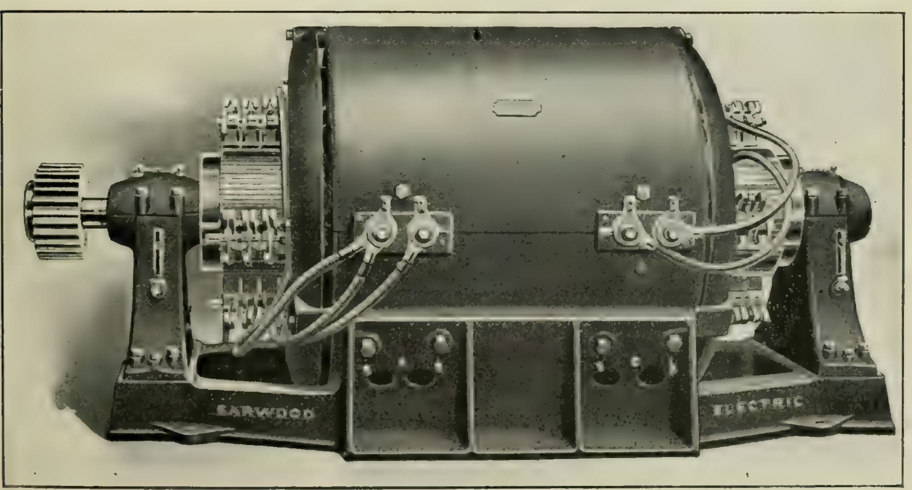
Compressed Air. *m.* New York.
Comptes Rendus de l' Acad. des Sciences. *w.* Paris.
Cornell Civil Engineer. *m.* Ithaca.
Deutsche Bauzeitung. *b-w.* Berlin.
Die Turbine. *s-m.* Berlin.
Domestic Engineering. *w.* Chicago.
Economic Geology. *m.* New Haven, Conn.
Electrical Age. *m.* New York.
Electrical Engineer. *m.* London.
Electrical Engineering. *w.* London.
Elec. Review and W. Elec'n. *w.* Chicago.
Electrical Review. *w.* London.
Electric Journal. *m.* Pittsburg, Pa.
Electric Railway Journal. *w.* New York.
Electrical World. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.
Elektrische Kraftbetriebe u Bahnen. *w.* Munich.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnik u Maschinenbau. *w.* Vienna.
Elektrotechnische Rundschau. *w.* Potsdam.
Elettricità. *w.* Milan.
Engineer. *w.* London.
Engineering. *w.* London.
Engineering-Contracting. *w.* New York.
Engineering Magazine. *m.* New York and London.
Engineering and Mining Journal. *w.* New York.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penna. *m.* Pittsburg, U. S. A.
Foundry. *m.* Cleveland, U. S. A.
Génie Civil. *w.* Paris.
Giesserei-Zeitung. *s-m.* Berlin.
Glasers Ann. f Gewerbe & Bauwesen. *s-m.* Berlin.
Heating and Ventilating Mag. *m.* New York.
Horseless Age. *w.* New York.
Ice and Cold Storage. *m.* London.
Ice and Refrigeration. *m.* New York.
Il Cemento. *s-m.* Milan.
Industrial World. *w.* Pittsburg.
Ingegneria Ferroviaria. *s-m.* Rome.
Ingenieur. *w.* Hague.
Insurance Engineering. *m.* New York.
Int. Marine Engineering. *m.* New York.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron Trade Review. *w.* Cleveland, U. S. A.
Jour. of Accountancy. *m.* N. Y.
Journal Asso. Eng. Societies. *m.* Philadelphia.
Journal Franklin Institute. *m.* Philadelphia.
Jour. N. E. Water Works Assn. *qr.* Boston.
Journal Royal Inst. of Brit. Arch. *s-q.* London.
Jour. Roy. United Service Inst. *m.* London.
Journal of Sanitary Institute. *qr.* London.
Jour. of South African Assn. of Engineers. *m.* Johannesburg, S. A.
Journal of the Society of Arts. *w.* London.
Jour. Transvaal Inst. of Mech. Engrs., Johannesburg, S. A.
Jour. of U. S. Artillery. *b-m.* Fort Monroe, U. S. A
Jour. W. of Scot. Iron & Steel Inst. *m.* Glasgow.
Journal Western Soc. of Eng. *b-m.* Chicago.
Jour. of Worcester Poly. Inst., Worcester, U. S. A.
Locomotive. *m.* Hartford, U. S. A.
Machinery. *m.* New York.
Manufacturer's Record. *w.* Baltimore.
Marine Review. *m.* Cleveland, U. S. A.
Mechanical Engineer. *w.* London.
Mechanical World. *w.* Manchester.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Metallurgical and Chem. Engng. *m.* New York.
Métallurgie. *w.* Paris.
Metal Worker. *w.* New York.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci. Press. *w.* San Francisco.
Mining Journal. *w.* London.
Mining Magazine. *m.* London.
Mining World. *w.* Chicago.
Mittheilungen des Vereins für die Förderung des Local- und Strassenbahnwesens. *m.* Vienna.
Municipal Engineering. *m.* Indianapolis, U. S. A.
Municipal Journal and Engineer. *w.* New York.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Oest. Wochensch. f. d. Oeff. Baudienst. *w.* Vienna.
Oest. Zeitschr. Berg- & Hüttenwesen. *w.* Vienna.
Plumber and Decorator. *m.* London.
Power and The Engineer. *w.* New York.
Practical Engineer. *w.* London.
Pro. Am. Ins. Electrical Eng. *m.* New York.
Pro. Am. Ins. of Mining Eng. *m.* New York.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Pro. Am. Soc. Mech. Engineers. *m.* New York.
Pro. Canadian Soc. Civ. Engrs. *m.* Montreal.
Proceedings Engineers' Club. *qr.* Philadelphia.
Pro. Engrs. Soc. of Western Pennsylvania. *m.* Pittsburg.
Pro. St. Louis R'way Club. *m.* St. Louis, U. S. A.
Pro. U. S. Naval Inst. *qr.* Annapolis, Md.
Progressive Age. *s-m.* New York.
Public Works. *qr.* London.
Quarry. *m.* London.
Queensland Gov. Mining Jour. *m.* Brisbane, Australia.
Railway Age Gazette. *m.* New York.
Railway and Engineering Review. *w.* Chicago.
Railway and Loc. Engng. *m.* New York.
Railway Master Mechanic. *m.* Chicago.
Revue d'Electrochimie et d'Electrométallurgie. *m.* Paris.
Revue de Mécanique. *m.* Paris.
Revue de Métallurgie. *m.* Paris.
Revue Gén. des Chemins de Fer. *m.* Paris.
Revue Gén. des Sciences. *w.* Paris.
Revue Industrielle. *w.* Paris.
Rivista Marittima. *m.* Rome.
Rudder. *m.* New York.
Schiffbau. *s-m.* Berlin.
School of Mines Quarterly. *q.* New York.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Sibley Jour. of Mech. Eng. *m.* Ithaca, N. Y.
Signal Engineer. *m.* Chicago.
Soc. Belge des Elect'ns. *m.* Brussels.
Stahl und Eisen. *w.* Düsseldorf.
Stevens Institute Indicator. *qr.* Hoboken, U. S. A.
Surveyor. *w.* London.
Technik und Wirtschaft. *m.* Berlin.
Technique Moderne. *m.* Paris.
Tramway & Railway World. *m.* London.
Trans. Inst. of Engrs. & Shipbuilders in Scotland, Glasgow.
Wood Craft. *m.* Cleveland, U. S. A.
Yale Scientific Monthly. *m.* New Haven.
Zeitschr. f. d. Gesamte Turbinenwesen. *w.* Munich.
Zeitschr. d. Mitteleurop. Motorwagen. Ver. *s-m.* Berlin.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschr. f. Werkzeugmaschinen. *b-w.* Berlin.

THE CURRENT RECORD OF IMPROVED MACHINERY
NEW METHODS NEW MATERIALS
NEW APPLIANCES

Newspaper Press Drive.

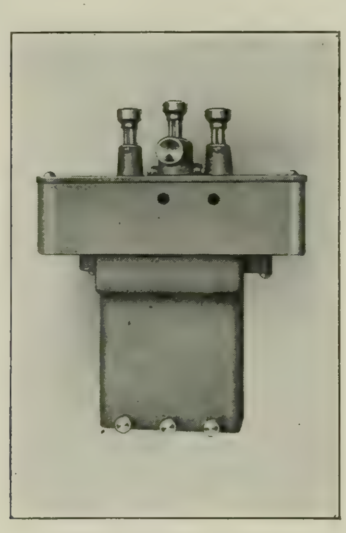
THE accompanying illustrations show the motor and control station as used in the Garwood Electric Company's "station control system" for driving printing presses, which has solved the newspaper press drive. The motor is of the protected type, and is extremely rugged; but a single set of spur gears is used, eliminating all trouble with clutches, worm wheels, or intermediate gears. No change of gears is necessary in color work, as is the case with other systems. The shaft is of liberal diameter; the magnetic frame is split horizontally, permitting easy removal of the top of it, while the removable bearings are of the pedestal type with separate caps and split bushings. Because of its design, no outboard bearing is necessary, although it will be furnished if desired. All parts are readily accessible in the limited space in the motor pit, which with this system is materially smaller than in the two-motor drive.

The brush rigging and brush holders are rigidly designed to prevent vibration being transmitted to these parts by the gears. Owing to the exacting requirements of newspaper press drive, standard commercial motors are not adapted to this service, and will not stand up well under the work. This motor is of the commutated pole type, designed especially



GARWOOD MOTOR FOR NEWSPAPER PRESS DRIVE.

for this particular service, developing the heavy torque required for starting. All speed changes are obtained by field control, and not by the wasteful method of armature resistance, and all danger from sparking and cutting of the commutator is entirely eliminated.



GARWOOD CONTROL STATION.

The control stations include three buttons: (a) starting, accelerating, and safety button for starting and increasing the speed of the press, including inching and "threading in," it being equipped with safety device for locking the press against any further increase in speed until released at the station at which it was applied, but allowing it to be slowed down to ten revolutions, or to be stopped from any station while the press is at "safety"; (b) a slow-down button for decreasing the speed of the press from maximum to ten revolutions of the cylinder; (c) stop and lock button for stopping and locking the press simultaneously and holding it locked until the locking device has been released at the station at which is was applied.

Pressing the stop button not only stops the press, but locks it at every station until the automatic check on the stop button is released at the station where it was applied, thus making it absolutely safe for any pressman, by merely stopping the press, to go under it without danger.

The Garwood Electric Company, Garwood, N. J., have published Bulletin No. 505-G, illustrating and describing in detail their form of newspaper press drive, and they will furnish same free of charge to all inquirers.

Foos Gas Engine Installation.

THE complete success of the two installations of large Foos vertical gas engines by the U. S. Government on the Ohio River improvement work has led to the placing of another order with the Foos Gas Engine Company for six engines, four of which are 100 horse power each, of the three-cylinder vertical type, which will embody the new features of the Foos design. This order will be divided and shipped to two different points, where the engine will be used in the operation of locks which the Government is building in the Upper Ohio Valley to provide sufficient water to obtain continuous freight navigation during the dry season.

The Foos engines were originally installed largely as an experimental measure, but such satisfactory results were obtained that the Government placed the subsequent orders with the same company for the engines in connection with this work, which involves an expenditure of millions of dollars.

The locks at each dam are operated by compressed air furnished by compressors belted direct to each of the 100 horse power Foos units. Each engine will be capable of developing 100 horse power continuously and under rigid specifications regarding speed regulation, fuel economy, reliability, ease of handling, and quickness of starting.

The other engines will be used for auxiliary purposes. The order calls for

Foos engines operating on natural gas, but each unit will be so arranged as to be quickly adapted for the use of gasoline or kerosene, in order to prevent any interruption of the service in case of a shortage or temporary failure of the gas supply.

Turbo-Undergrate Blower.

THE B. F. Sturtevant Co., Hyde Park, Mass., have recently placed a turbo undergrate blower upon the market that deserves careful consideration by all engineers who have supervision of steam generating plants. The construction of these blower sets is simple, durable and strong, and consists of a single stage impulse steam turbine direct connected to a propeller type fan. The bucket wheel of the turbine is a solid steel forging carefully machined, the steam buckets being milled on the periphery of the bucket wheel. The steam nozzles are made of Tobin bronze and are held in place by composition draw-up nuts. The construction of the steam case gives great accessibility for inserting, removing or cleaning the steam nozzles. Ample dust-proof phosphor-bronze bearing and thrust washers are provided, with oil cup lubrication. The construction of the bearing makes it possible to renew the bearing at a small cost.

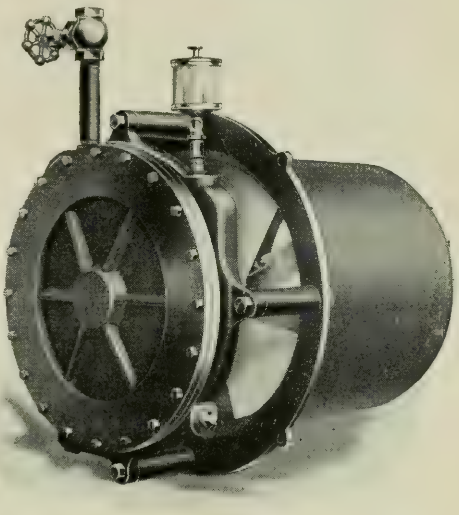
The built-up fan is of the propeller type and consists of six polished sheet aluminum blades rigidly fastened with hard drawn copper rivets into a bronze hub, which is finished all over to secure the proper balance necessary for the high rotative speed of these sets. The materials used in the construction of the fan insure great mechanical strength and also great corrosive resisting power.

The stationary members of the blower set are constructed of cast iron parts of ample strength and rigidity.

The Sturtevant turbo undergrate blower is practically silent in operation and requires a minimum amount of care and attention, as it can be controlled by a hand damper regulation or by regulating valves operated by the boiler steam pressure.

As the exhaust steam from the turbine contains no oil it may be used to best advantage for any work for which exhaust steam may be put, such as feed water heaters, heating, etc.

When discharging into the ash pit it produces excellent results with coals that would ordinarily cause serious trouble by clinkering.



STURTEVANT TURBO-UNDERGRATE BLOWER.

The cost of installation is exceedingly small. The wall thimble which forms the anchorage for the set can be placed with equal ease in the front, side or back wall of the brickwork of the boiler setting. The ease of installation combined with the small cost of these turbo undergrate blowers should make them of special interest to all plants that desire to increase their boiler capacity, or in cases where the maximum efficiency is not being secured by the fuel.

These blower sets can be applied with excellent results to power plants that fall under the following classifications:

(1) electric light and railroad plants that need increased draft during the peak of the load; (2) power plants that

have outgrown their stack capacity and need 25% to 50% increase in B. H. P.; (3) in heating systems for hotels, department stores, flats, schoolhouses, etc.; and (4) in small plants that need an increase in boiler horse power.

Quincy Market Refrigerating Plant.

THE distribution of light, heat and power from central stations or power plants has for years been well established, but the supplying of mechanical refrigeration to the market district of a large city is a comparative innovation and presents many novel features that are exceedingly interesting.

An example of such an installation is that of the Quincy Market Cold Storage and Warehouse Company, of Boston, Mass. This company owns twelve warehouses in the market district of the city, which are rented to wholesale dealers and for which refrigeration is supplied. Beside the warehouses, refrigeration is furnished to the Clinton Market, which is the headquarters of the Chicago packing houses in Boston, and to about seven hundred refrigerators in individual stores.

The power house is at Sargent's wharf, which is embraced by the market district and is admirably situated for economical distribution. The compressors for the refrigeration plant are steam-driven, but the auxiliary apparatus used in connection with the system, as well as elevators, hoists, etc., are operated by electric motors, all of which are furnished by the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.

For cooling the warehouses, the brine is pumped to coils of pipes in various parts of the buildings and the cooled air circulated to different departments by means of fans. The brine is circulated by a two-stage brine pump driven by a 75 horse power type "CCL" motor, and two single-stage brine pumps, each driven by a 40 horse power type "CCL" motor. The fans are driven by five 10 horse power, four 7½ horse power, two 15 horse power, and one 50 horse power induction motors. For the street system which supplies individual consumers, there is a two-stage brine pump driven by a 150 horse power induction motor, and a rotary brine pump driven by a 100 horse power induction motor.

The motor equipment for operating warehouse elevators consists of five 30 horse power, four 15 horse power and two 7½ horse power induction motors belted to the operating mechanism, and four type F adjustable speed motors of 20 horse power capacity, direct connected to operating mechanism. There are a large number of miscellaneous motor applications, including a 3 horse power type "CCL" motor driving fuel economizer scrapers, a 5 horse power induction motor driving a small machine shop, a 10 horse power induction motor driving the carpenter shop, a 10 horse power "CCL" motor operating hoisting whips, a 7½ horse power induction motor driving pipe shop, four 5 horse power induction motors driving meat grinders, a 15 horse power "CCL" motor driving drum hoist, a 3 horse power type "CCL" motor driving centrifugal circulating pump for office hot water heating system, a one horse power type "CCL" driving pressure oil system for oiling engines, and a 10 horse power induction motor driving a triplex pump.

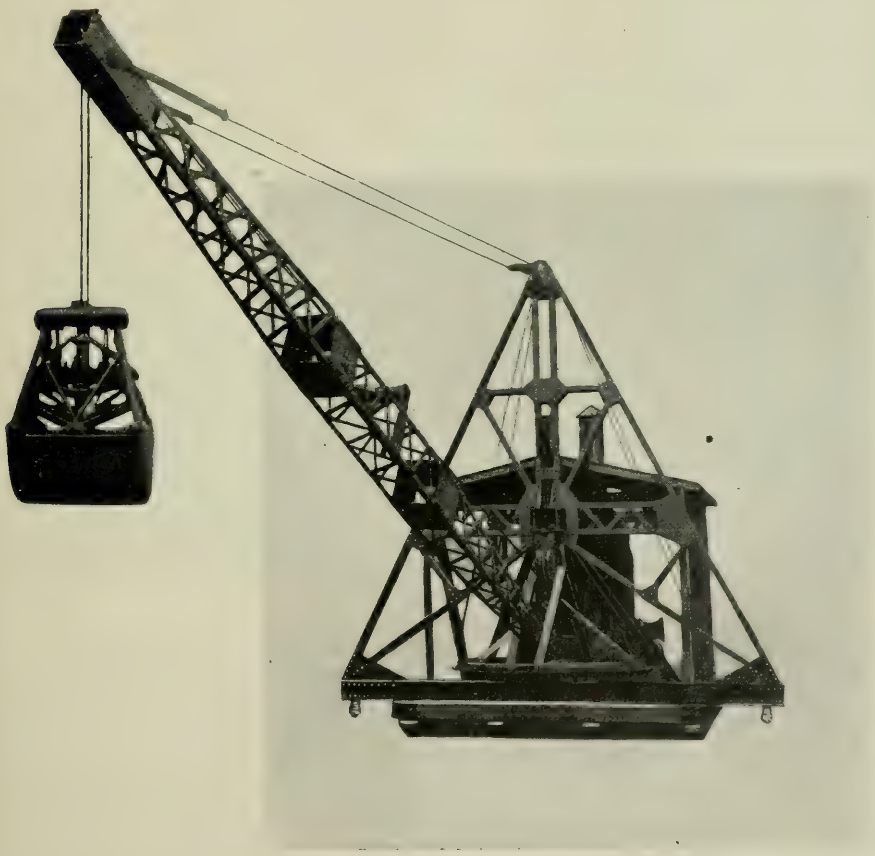
Power is furnished by a Westinghouse 300 kilowatt, two-phase, 60 cycle, 450 volt, turbo generator excited by a 10 kilowatt, 125 volt, direct current generator.

Hayward Skid Excavator.

THE accompanying illustration shows the Hayward skid excavator with the steel "A" frame and boom mounted on a wooden frame. This type of machine may be used in three ways. The first, as shown here, as a machine with a bull wheel, stationary topping-lift and automatic bucket. The second type is made by adding a sheave and substituting sheave block at the apex of the "A" frame. With this change a variable topping-lift may be used. The third style is when the bull wheel is entirely eliminated, two swivel blocks are placed on the "A" frame sill and two more on the "A" frame, and the lines led to the engine drum, making what is called an automatic swing. This can all be done with the same machine.

It can be knocked down and set up more quickly than a machine built entirely of wood. All its material is lighter and cast in smaller pieces so that it is far easier to handle and transport from one place to another, thus saving time, money, and labor.

The "A" frame and engine can be removed from the platform and placed on a scow, thus making a standard type of dredge. By adding a few bracing rods and extra timbers the machine can be mounted on wheels, making a machine of wide gauge. The "A" frame and sill may be mounted on an ordinary flat car and used as a traveling machine on a standard guage road. When so arranged, however, it can only be used on sidings as the "A" frame would project too far to use on main railroad lines. If the machine is rigged to use a variable topping-life the bucket may be eliminated, and the



HAYWARD SKID EXCAVATOR.

machine then used as a regular derrick or as a contractor's derrick.

Pamphlet No. 565 describing this excavator in detail will be sent free on request by the Hayward Company, 50 Church street, New York.

Friction Losses.

SCIENTIFIC tests by prominent authorities have proven conclusively that friction losses are much reduced and the carrying capacity of the bearings greatly increased when the lubricant contains the correct proportions of Dixon's flake lubricating graphite, and these tests are proven by actual experiences.

Sometime ago Prof. W. F. M. Goss, Dean of the College of Engineering, University of Illinois, made some tests with the Dixon flake lubricating graphite on ball bearings. As a result of these tests, Professor Goss says in part that the following conclusions may be drawn:

"A combination of graphite and lard oil makes up a lubricating mixture which, when applied to ball bearings, will accomplish everything which lard oil alone will do and which at the same time will give a lower frictional resistance of the bearing and permit a large increase in the load which it may be made to carry.

"An oil as light as kerosene, when intermixed with graphite, will be converted into an effective lubricant for ball bearings when operated under light or medium heavy pressure.

"Even so viscous a lubricant as vaseline will better perform a given service in the lubrication of ball bearings when supplemented by small amounts of graphite. The bearing to which the mixture is applied will work with less frictional resistance and will carry a heavier load than when vaseline alone is used.

"The admixture of graphite with either a liquid or viscous lubricant, serves both to reduce the friction and to increase the possible load which a bearing thus lubricated can be made to carry."

The Joseph Dixon Crucible Company of Jersey City, N. J., have a record of Professor Goss' extensive tests with graphite as a lubricant published in pamphlet form under the title of "A Study in Graphite," which is sent free on request.

Electrolytic Lightning Arresters.

MANY devices have been placed on the market for the protection of electric equipment from abnormal voltage on the line, due to lightning or any other cause, but without question the most effective piece of apparatus ever devised for this purpose is that type of lightning arrester which depends upon the safety-valve action of a film on an aluminum plate. This type is commonly known as the electrolytic arrester and, in practice, consists of nested aluminum trays filled with electrolyte and submerged in oil.

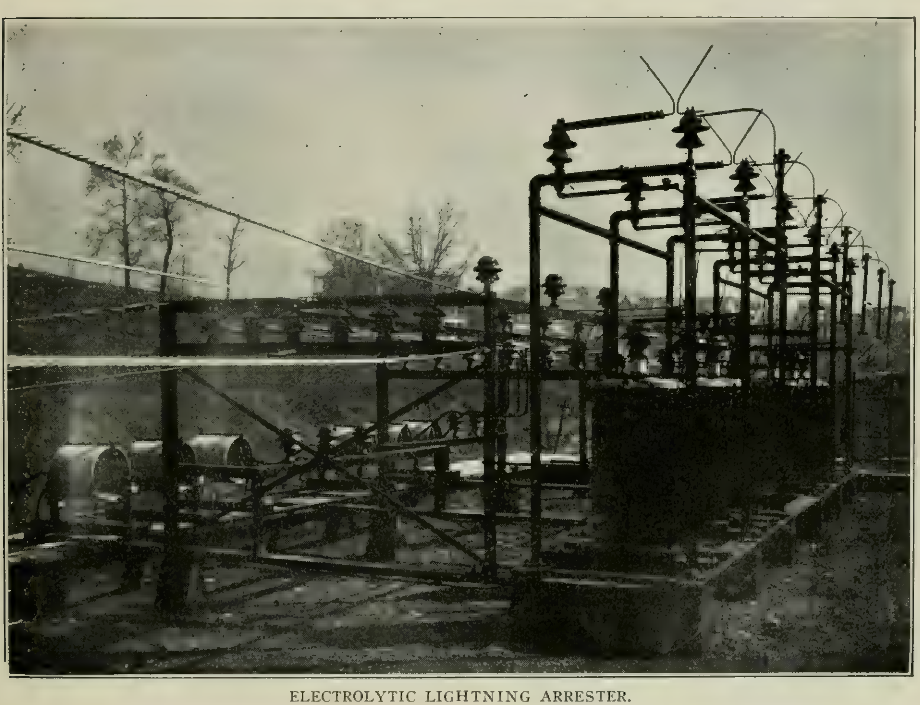
The electrolytic lightning arrester has ideal characteristics, and very closely resembles in action a relief or safety valve, which it truly is for the electric system. The horn gaps which are between the arresters and the line break down on over voltage and if this voltage amounts to over approximately 330 volts per tray, a free passage through the film from tray to tray and thence to the ground is provided. When the voltage drops to normal, which is below the critical voltage of the tray, the apparent resistance of the film reasserts itself and the flow of the current is cut down so that the horn gaps disrupt the arc and all further flow of current ceases.

The nested trays are placed in oil-filled, welded steel tanks, which for 22,000 volts and above are built with cast covers and outdoor terminals, so that the entire arrester can be placed outdoors. The complete arrester consists of four tanks mounted on an insulated platform for ungrounded neutral service, and three tanks grounded for grounded neutral service. For 13,200 volts and under, the arrester is arranged for indoor service only, as the horn gap setting is so small that much more effective service is obtained when the arrester is housed. For the lower voltages the general arrangement of trays is the same, but a smaller number of tanks is used.

Since the film on the plates dissolves when the electrolytic type of arrester is allowed to stand without current passing through it, it is necessary to pass current through the arrester periodically in order to keep the film in the best condition. This prevents an abnormal rush of current when the arrester discharges after a long period of idleness.

The rate of dissolution of the film depends upon the kind of electrolyte used and the temperature. There are two kinds of electrolyte made by the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.; one which requires that the horns be bridged daily to pass current through the arresters, and the other which requires that the horns be bridged only every seventh day. The latter electrolyte has been known to stand without current for very long periods during cold weather, and when the horns were bridged no undue rush of current followed. However, in order to keep the films well built up, it is recommended that current be passed through this electrolyte every seventh day; this offers no inconvenience, as apparatus in general should be inspected at least this often.

When arresters are bridged at normal voltage, a bluish, crackling static arc indicates the normal condition of the arrester. If the arc is reddish and fluffy, and rises high on the horns, it is evident that the bridging of the horns has been deferred too long a time, and it will take a short period before the arc comes down to normal.



ELECTROLYTIC LIGHTNING ARRESTER.

The horn gaps and bridging device are mounted on a two-inch pipe frame, to which is also attached the transfer switch used for interchanging a ground and phase tank on ungrounded neutral arresters. The bridging device is very simple and can be operated from either end.

As the voltage increases the number of trays in the arrester also increases. Hence, for a higher voltage, if the trays were all built in a continuous structure, it would be very awkward to handle and require considerable overhead room when installed indoors. For this reason, on all arresters above 13,200 volts, the Westinghouse tray structure is built up into sections containing not over 50 trays, which slide into place, one above the other, between guides supported by a base casting fitting closely to the bottom of the tank. Each section when filled with electrolyte can be easily handled without danger of upsetting it. The electrolyte is poured into the trays by means of a measuring cup, which contains the correct amount of liquid for each tray. When a section of trays is filled the electrolyte is plainly visible so that each tray can be checked.

All parts of the supporting frame directly in contact with the trays are made of the best grade of porcelain; hence, any danger due to burning supports, which is likely to be present in case wood is used is entirely eliminated.

If a ground on one phase occurs when the horn gaps are set to get the maximum protection from the arrester, the horn gaps connected to the other phases will discharge until the line is cleared, or is thus subjected to a continuous discharge that may last a long time, the Westinghouse arresters are designed with large tanks holding sufficient oil to absorb the heat of a continuous discharge lasting over a considerable period. The tanks are built large in diameter so that the clearance between the top tray and tank where the maximum voltage exists provides a good insulation factor of safety.

Centrifugal Tar Extracting Apparatus.

PERHAPS the greatest difficulty encountered in the operation of gas engines in connection with soft coal producers is in the proper cleaning of the gas. The raw gas as it comes from the ordinary up-draft soft coal producer is unfit for use, as it contains a very large percentage of vaporized tar, lamp black, ash and sulphur. Of these impurities tar, even in very minute quantities is most detrimental to the operation and proper regulation of the gas engine. This is owing to the fact that so long as there is any tar vapor present in the gas it will condense on any metallic surface. The condensation is greatest wherever there is a sudden change of direction, or a sudden change in velocity as in passing through the valves of the gas engine. A continued deposit of tar on these parts soon causes the engine to regulate badly and in time prevents governor action altogether, causing breakage of the valve mechanism and other parts of the engine, causing the engine to stop completely owing to insufficient supply of gas for the load, or permitting the engine to run away owing to an excess supply of gas. Thus it may be seen that thorough cleaning of the gas is necessary in producer power plant operation. Indeed it is this feature which has been the great drawback to the general adoption of the gas engine for power production. It is only by use of some thorough and reliable means of cleaning the gas that the producer operated gas engine may be placed in the same class with respect to reliability as the steam engine or steam turbine.

As an example of the efficiency of a modern system of purifying producer gas, the equipment of the Penn-American Plate Glass Company, at Alexandria, Ind., is of special interest. A portion of their power equipment consists of a producer operated gas engine plant comprising three 500 horse power Koerting, and a 300 horse power vertical Westinghouse engine, engines direct connected to generator, making a total of 1,800 horse power, which may at times be subject to 10 per cent. overload. These engines are supplied with gas by four 500 horse power updraft soft coal producers of the usual type. An interesting feature of the installation is that no gas holder is used or found necessary, and when under full load the engines draw their own gas under a vacuum of ½ inch to 1 inch water gauge. The producers are supplied with forced draft by means of steam jets or inspirators, which provide sufficient pressure to overcome resistance of the fuel bed and to deliver the raw gas into the main under a pressure of from 1½ inches to 2½ inches water gauge, whence it passes through the cooling tower to the tar extractor. This plant has been in operation for a number of years, but has until recently been operated with the greatest of difficulty owing to the impurity of the gas. This was in part due to the fact that the coal used was unusually high in volatile matter, but more particularly to the fact that the two types of scrubbers previously used proved inefficient. Both of these scrubbers comprised a cylindrical stationary shell within which was a rotating cylinder provided with numerous exterior blades or paddles. An ample supply of water was introduced between the rotating and stationary drums. Not only did these scrubbers prove unsatisfactory as to the removal of tar, but they gave a great deal of trouble by getting out of balance, owing to accumulation of tar upon the rotating parts while in operation. They were finally abandoned, and in March last a Buffalo turbine tar extractor, manufactured by the Buffalo Forge Company, of Buffalo, N. Y., was installed, which has been in satisfactory operation ever since. This extractor is of the centrifugal type and comprises an outer cast iron shell, which is divided vertically into two separate stages, each provided with a rotor. The rotors are constructed entirely of monel metal, which is a natural alloy of about 80 per cent. pure nickel and 20 per cent. copper. This is the most nearly acid proof construction metal known, with the exception of lead, and is scarcely affected by the action of the sulphuric acid in the gas. It also has the advantage of possessing the high tensile strength of about 80,000 pounds per square inch.

All interior parts of the scrubber are of cast iron or monel metal. The shell is provided with numerous hand holes for inspection of all parts, and in addition is divided horizontally so that the entire rotor and shaft may be removed without disturbing the bearings or the alignment of the casing. The shaft is mounted upon self-aligning spherical ring oiling bearings which are attached to the shell of the extractor. The extractor is driven at 1,800 revolutions per minute by a direct connected 60 horsepower Terry steam turbine.

The water is thoroughly distributed to all parts of the scrubber by means of cyclone nozzles at a pressure of about 15 pounds. These nozzles, which are also of monel metal, are of the atomizing type and of the simplest construction, operating on the centrifugal principle. This type of nozzle is particularly adapted to this service, since its interior is free from any obstruction which would tend to collect foreign material in the water. As an additional precaution, the water is first passed through two Buffalo pot strainers, which permit easy cleaning while the plant is in operation. The nozzles are supplied with water through cored chambers in the shell, and by a special construction are all made accessible from the outside. About 85 gallons of water per minute is required for operation.

The beneficial effect of the second stage is shown both in the greater economy of water consumption, and the marked increase in efficiency of cleaning. The difference in the color of the water of the two stages is most marked.

It is interesting to note that after a long period of operation not the slightest trace of tar or lamp black was to be found in the gas main leading from the scrubber. The four gas engines are operating continuously 24 hours a day, 6 days a week. Examination at the end of the week has shown that any cleaning of the engine was unnecessary. The absence of tar in the gas permits the governors to regulate perfectly, no trouble having been found from this source since the installation of the Buffalo apparatus. Breakdowns and failures of the engine, which had previously been so common, are now substantially done away with. Indeed the experience with this plant has shown that the proper cleaning of the gases is the most difficult as well as the most vital feature of the producer installation. Tests upon the cleaned gas showed only a trace of foreign material, the amount being .00031 grains per cubic foot. This seemed in part to be a very little tar and partly a very fine lamp black, this amount, however, being so small that it had no effect whatever on the engine. A particularly pleasing feature of the installation is that the construction of the rotor is such that there is no collection of tar on any part of it to produce an unbalancing and a consequent vibration, which had been found so serious with other types. Examination of the rotor after long periods of operation show it to be as free of accumulation of tar as upon the first day of operation. The balance of the rotor remains so perfect, that it is difficult to tell when the machine is running. The scrubber receives a thorough cleaning with steam once a week, which is all that is found necessary; this requires about one-half hour, and necessitates no manual work whatever.

The Rife Hydraulic Ram.

THE improvement made in the contruction of hydraulic rams from the day of their invention by Montgolfier, in 1776, was practically nil until the Rife ram was designed. The Rife machines are now built with automatic, air feeding device preventing water-logging and destruction by concussion, and are now being used for town water works, irrigation and railroad tank supply, as well as for farms, domestic purposes, etc. The following illustration shows a plant installed for the Pennsylvania Railroad Company. The water used to operate the Rife rams is conveyed through a 6 inch pipe line, 1,400 feet to the intermediate reservoir, to which the drive pipes are connected, as shown on the accompanying illustration. Fall used, 12 feet; water used, 120 gallons per minute; pumping head, 39.4 feet; water delivered, 28 gallons per minute; efficiency developed, 70 per cent.

Over thirty of the prominent railroad systems use Rife rams, which effect considerable saving, as they run constantly without attention or expense except for new valves every year or two, thus eliminating the cost of fuel and attendants. A plant recently installed for a town in Kansas delivers 600,000 gallons of water daily, replacing a steam plant that cost $25 a day for operation, the rams costing less than fifty cents per day for maintenance. The Rife Engine Company recently received a single order for one hundred of these machines for a South American Government contract. They claim for their rams: constant operation under two or more feet fall, water elevated 30 feet for each foot of fall used, and efficiencies ranging from 60 per cent. to 90 per cent.

RIFE HYDRAULIC RAM.

Catalogues, estimates, drawings and blue prints will be sent free upon request.

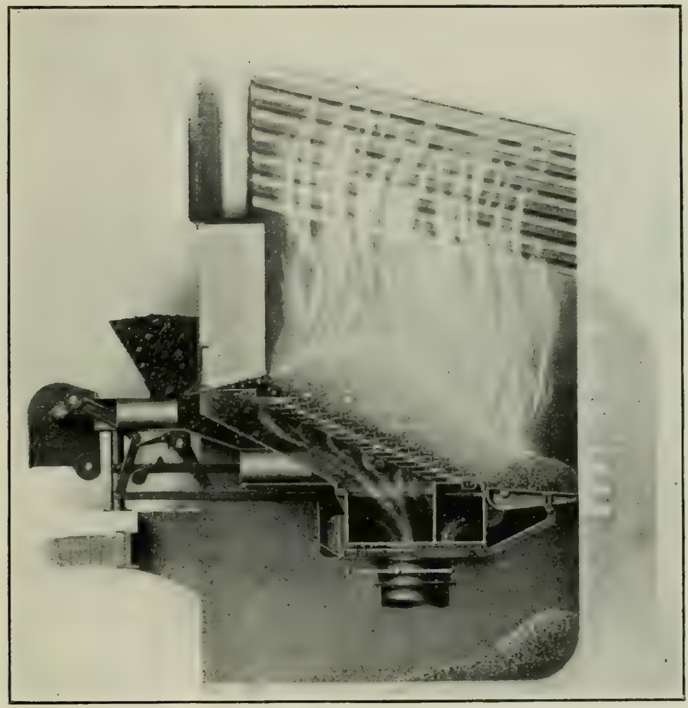
Improved Stoker For High Rates of Combustion.

THE Taylor stoker has been developed to dispose of the refuse so readily that coal can be burned in the large quantities necessary for operating boilers at double their rated capacities. It makes possible the concentration of load on a few boilers and the minimizing of losses by maintaining intense fires and rapid circulation. It thus meets the conditions of what undoubtedly will be the boiler practice of the future.

The difficulties encountered in the disposal of the large amounts of ash resulting from high rates of combustion have been overcome in the Taylor by feeding the coal beneath the burning fuel, at an angle to the fire surface, so that gravity is utilized in carrying the burned-out coal to the dumping plates at the rear as well as in the distribution of the fuel. No other stoker can burn so much coal, simply because no other can take care of so much refuse.

From the first, the fundamental design of the Taylor has remained unchanged because of early recognition of the importance of ash removal; but improved mechanism has been necessary as larger and larger stokers have been called for. These changes relate principally to the operation of the lower line of plungers, which push the burned-out coal onto the dumping plates.

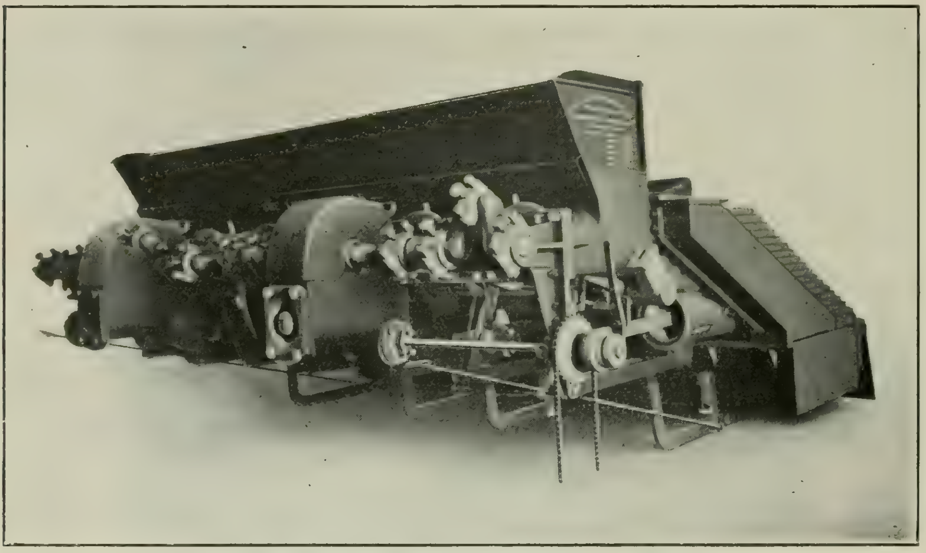
The travel, or length of stroke, of the upper row of rams which assist gravity by pushing the coal outward into the fire is constant, but the travel of the lower row can be increased to push the refuse out more rapidly just after the dumping plates have been dropped, or whenever it is desired to more quickly get rid of the refuse which has collected in the lower part of the furnace.



SECTIONAL VIEW OF TAYLOR UNDERFEED STOKER.

As previously built, each lower ram was connected directly to the bell crank which operated the upper plunger. Adjustment of the stroke of the lower plungers was made for each separate retort. With the improved mechanism, the travel of all the lower rams may be lengthened or shortened simultaneously. This is accomplished by means of sort of pantograph lever connection having a cam and balance weight on the upper member. Pivoted to the plunger connecting rods, these cams are connected by means of chains, lever arms and shaft to the operating handle at the center of the stoker. To alter the travel of the lower rams the adjusting lever is dropped, releasing the cams and permitting them to become horizontal, which action lengthens the stroke of the plunger. In case the vertical connection of the bell crank lever is in such position that the cam cannot drop, it merely remains at rest until the connection moves backward and the counterblance weight falls and carries the cam into position.

Another change which simplifies the operation of the stoker is the relocation of the speed shaft sprocket. It is now placed at the end of the stoker with the clutch and face plates which hold the shearing pin on the outside. This greatly facilitates the replacing of the shearing pins when required and also the throwing of the stoker on or off the line. It also improves the connection to the fan shaft.



PERSPECTIVE VIEW OF TAYLOR UNDERFEED STOKER.

A third improvement is the alteration of the dumping plates. In early forms, the dumping plate was cast in one piece, but the present design calls for a dumping plate in sections which are independently renewable, facilitating and lessening the cost of repairs. Improvements of minor importance, but which nevertheless make for simplicity, more certain operation, and reduction of repair charges, are the use of lock nuts in all places where possible jar would tend to loosen ordinary nuts, the fitting of the crank shaft brackets to the ram boxes with body bound bolts, and an increase in the size of the gears in the gear boxes and the shaft and bearings. To insure more certain connection between the cast-iron ram boxes and the tuyere boxes they are now carefully doweled together.

Air Compressor Lubricator.

THE Detroit Lubricator Company, Detroit, Mich., has recently put out an air compressor lubricator which marks an improvement over previous devices for lubricating the air cylinder of air compressors. The Detroit air compressor lubricator can be started and stopped without changing the feed and pressure adjustments. It is not even necessary to touch them. The Detroit "500," as it is called, has three valves. An oil valve controls the admission of oil to the valve, which in turn regulates the rate of feed. A valve in the support arm prevents excessive back pressure which would cause the oil to spatter the sight feed glass. The oil supply valve allows a permanent adjustment of the feed and pressure valves, because it alone controls the admission of the oil to the feed and the other valves do not have to be turned off to stop the feed and turned on to start it. After the adjustment is once made it stays right, because it never has to be changed.

AIR COMPRESSOR LUBRICATOR.

There is no waste of time, effort and oil every time the machine is started. All the operator has to do is give the oil valve three or four turns and the oil runs through the other valves just as it did the day before, and the day before that, because the adjustment is exactly the same and was not changed. The economy in oil is considerable. It has none of the disadvantages of the leaky snap stem type.

The Detroit "500" is strong and substantial throughout, designed for rigorous service and carefully made. The gauge glass in the body is of the bull's-eye type and capable of withstanding any pressure to which it may be subjected. This lubricator is furnished in two types, the "500" regular with heavy tubular glass for pressures not exceeding 300 pounds, and the "500" extra heavy with bull's-eye glass for pressures of 300 pounds or more.

Pluvinox Reinforced Railroad Roofings.

"PLUVINOX" is a ready roofing, especially designed in its ingredients and construction to withstand the smoke, cinders, fumes, sparks, vibration, wear and tear, and other severe conditions of railroad work. Such a use and test commend the roofing for any class of buildings, particularly foundries, gas plants, acid works, factories, and structures near the sea.

Salt air destroys tin and iron, but does not injure "Pluvinox" roofings. They are also alkali and acid fume proof.

"Pluvinox" roofings are (except the one-ply) built up in layers; that is, they contain from two to three sheets of fabric, with layers of waterproofing compound between the sheets, all thoroughly bonded together. The completed material is, in addition, coated top and bottom.

This roofing costs less than tin or shingles; does not rust like metal; is a non-conductor of heat and cold, and, therefore, insulates the roof. It is also odorless and does not taint rain water.

It is adapted to all climates, to flat or steep roofs, to any class of building, and can be easily applied. It is made in four weights, two reinforced, and two unreinforced. The two reinforced grades are unexcelled for their great strength. It is practically impossible to tear them with the hands.

"Pluvinox" is made by the Hydrex Felt and Engineering Company, 120 Liberty street, New York.

The Oneida Steel Pulley.

IT is only in comparatively late years that the idea of a pulley made entirely of steel has presented itself. The economy of such a pulley is very evident,—it is light, strong, serviceable and looks well on the shaft. Later on it was found that steel has certain properties which afford the best belt adhesion known.

Various companies began the manufacture of all-steel pulleys. Some failed in their purpose; others brought the steel pulley to a point where it is most economical.

ONEIDA STEEL PULLEY.

Notable among these is the Oneida Steel Pulley Company, Oneida, N. Y.

Their system of construction allows the greatest range of sizes and styles of any steel pulley made. They make pulleys from 6 inches to 126 inches in diameter with a 2 inch to 40 inch face to fit any standard size shaft from 1 inch to 8 inches in diameter. Besides the regular belt pulleys they make such specialties as conveyor drums, elevator, head, tail, and tripper pulleys, flanged pulleys, cork insert pulleys, and flanged pulleys for axle dynamos, used in car lighting service.

ONEIDA PULLEY WITH FISHPLATE REINFORCEMENT OF RIM.

The system of construction used by the Oneida Steel Pulley Company is unique,—one of the most prominent features being the fishplate system of fastening arm to rim, on pulleys above 20 inches in diameter. This fishplate makes a broad bearing for the arm, in fact it may be said that it answers the purpose of a double thick rim with no superfluous weight.

They also insert extra sets of arms or spiders in wide faced pulleys to afford support across every 8 inches of the entire width of the pulley; for instance, a pulley with a 24-inch face has three spiders, while a 40-inch face pulley has five spiders.

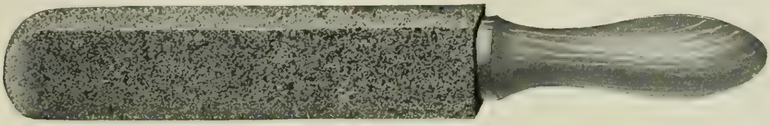
It is not necessary to use key-ways or set-screws to fasten the "Oneida" pulley to the shaft. The hub is so constructed that it grips the shaft securely without danger of slipping. A system of interchangeable cast iron bushing is also used. This allows the pulley to be used on several different sizes of shafting, by merely inserting the correct bushing.

The Oneida Steel Pulley Company offers to send a copy of their new illustrated 48 page catalogue to anyone who requests it.

Carborundum File.

THE Carborundum file continues its work where the steel file is forced to leave off, that is, besides doing all of the work a steel file can do, and doing is better and quicker, the Carborundum file will cut metals which the steel file cannot touch.

The Carborundum file is a solid block of carborundum 13 inches long, 1½ inches wide, and 1½ inches thick. One end is rounded, and the other fitted with a durable wooden handle. For filing castings or soft metals it does the work much quicker and better than the steel file, and for touching up case hardened parts and removing the scale from the harder metals there is nothing to equal it. The Carborundum file readily removes material which the steel file cannot even touch. Incidentally the Carborundum file will outlast twenty steel files.



CARBORUNDUM FILE.

Carborundum is the hardest and sharpest of all abrasive materials. Every little grit or grain in the Carborundum file is just as hard and just as sharp as a diamond, and they cut fast and clean, never wearing smooth and allowing the file to fill or glaze.

In general machine shop work the Carborundum file fills a long-felt want, as it not only does better and faster work than the steel file, but is much more economical in the end. It is made in a convenient size and shape, and of just the proper grit to be efficient in all around work. The Carborundum file can be had from hardware dealers, or from the Carborundum Company, Niagara Falls, N. Y.

Industrial Notes.

—The Industrial Supply and Equipment Company, 407 Sansom street, Philadelphia, Pa., have been appointed sales agents east of Pittsburg for the Brown Automatic Hose Coupling Company, Cleveland, Ohio, manufacturers of the Brown automotic hose coupler.

—"ABC" exhaust fans made by the American Blower Company, Detroit, Mich., are being used for elevating seed cotton on the estate of the Czar of Russia, his plantation being entitled the Imperial Mourgab Estate at Bairam-Ali, Turkestan, Russia. Of this estate, a Mr. Bouchoueff is chief engineer.

—The Triumph Electric Company, of Cincinnati, Ohio, announce a change in address and management of their Chicago office. W. R. Bonhan succeeds F. L. Merrill, as manager, and is located at No. 275 La Salle street, instead of in the Manhattan Building, as formerly.

—The Buffalo Steam Pump Company has recently reopened the St. Louis office in charge of H. H. Downes, 911 Third National Bank Building. Mr. Downes was transferred from the home office at Buffalo, and has had a wide experience with the products of the Buffalo Steam Pump Company, the Buffalo Forge Company, and George L. Squier Manufacturing Company.

—J. G. White & Co., Inc., engineers and contractors, 43 Exchange place, New York, have been awarded a contract by the New York, Ontario and Western Railway Company for the erection of railroad shops at their Mayfield yards, Mayfield, Pa., near Carbondale. The work to be carried out consists of the erection of a ten stall roundhouse, with a 75 foot turntable, machine shop, carpenter shop, with complete power plant, storehouse, office building, oil building, sand storage, drier and loading house, and a complete coaling station with a storage capacity of approximately 1,000 tons. The buildings will be of the usual type of brick and steel construction. The estimated cost is approximately $150,000.

NEW CATALOGUES AND TRADE PUBLICATIONS.

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Air Compressors.

Platt Iron Works, Dayton, Ohio, U. S. A.—A new and handsome bulletin of 40 pages, illustrating and describing the full line of Smith-Vaile Air Compressors, steam and power actuated. All the standard types and sizes are very fully presented, the designs of compressors for special duty are indicated, and the publication is replete with valuable tabular exhibits. Free on request.

National Brake & Electric Co., Milwaukee, Wis.—Publication No. 391, showing National motor and belt-driven air compressors for industrial service.

Blowers.

B. F. Sturtevant Co., Hyde Park, Mass.—Bulletin No. 175, showing in detail the high-pressure blowers.

L. J. Wing Mfg. Co., 2111 West Street Building, New York.—A handsomely printed pamphlet, twenty pages (6 x 9), illustrating and describing in detail the construction and operation of the "Typhoon" turbine blower—the simple mechanical device which is working a revolution in power-plant and furnace practice, because it does away with the need of high chimneys, is so small that it can be set in existing boiler walls, and so remarkably efficient that it seems to solve the problem of mechanical draft. Ask for Bulletin No. 7.

Coal-Handling Machinery.

Mead-Morrison Mfg. Co., Boston, Mass.—Catalogue No. 15, showing coal-handling machinery, electric and steam hoists, grab buckets, derrick swingers, belt hoists and suspension cableways. A great many photographic illustrations are shown, illustrating particular applications of complete coal unloading, storage and reclaiming installations. An examination of these illustrations must offer many suggestions for the successful treatment of handling problems.

Conveyers.

Jeffrey Mfg. Co., Columbus, Ohio.—Bulletin No. 42, illustrating many installations of coal handling and mine equipment. Photographs of the conveyors in place form the principal part of the book.

Electric Hoists.

Pawling & Harnischfeger, Milwaukee, Wis.—Bulletin No. 18, showing photographic illustrations of traveling electric hoists designed and built for various classes of service.

Electric Welders.

Toledo Electric Welder Co., Cincinnati, Ohio.—An illustrated catalogue showing the Toledo electric welders for welding iron and steel, copper and brass, rods, pipe, bar stock, etc.

Engines.

Ridgway Dynamo & Engine Co., Ridgway, Pa.—Bulletin No. 22, illustrating the parts of the Ridgway four-valve engine, built in simple, tandem compound, and cross-compound types.

Leather Specialties.

Detroit Leather Specialty Co., Detroit, Mich.—Folder entitled "Why," telling why "Wear-Well" leather packings are of long life, with special reference to "Mercury," a new leather particularly adapted to packings for hydraulic and compressed-air machinery.

Power-Plant Appliances.

Liberty Mfg. Co., 6910 Susquehanna Street, Pittsburg, Pa.—A set of bulletins, illustrating tube cleaners, blow-off valves, strainers, oil purifiers, separators, feed-water regulators, etc.

Pumps.

Buffalo Steam Pump Co., Buffalo, N. Y.—Catalogue No. 228, illustrating and describing in detail Buffalo vacuum pumps, jet, barometric and surface condensers of every description for all requirements.

Steam Engines.

Trenton Engine Co., Trenton, N. J.—Catalogue R, describing the Reeves engines for belted and direct connection. Particular attention is directed to the new type side crank. vertical, cross-compound engine and the new type of side crank, horizontal single-cylinder engine.

Steam Specialties.

Wright Mfg. Co., Detroit, Mich.—Catalogue No. 12, illustrating the Wright steam specialties, including high and low-pressure steam traps, safety alarm water columns, exhaust heads, filters, air traps, etc.

THE
ENGINEERING MAGAZINE
"THE WORLD IS ITS FIELD"

VOL. XL. JANUARY, 1911. No. 4.

MONOPOLY AND PROGRESS.

Dr. Franz Erich Junge-Hermsdorf.

THE FOUNDATION OF PRIVATE MONOPOLY POWER IN THE UNITED STATES.

Dr. Junge, by natural qualification and special opportunity and study, is remarkably fitted to discuss the peculiar economic conditions now disturbing industrial progress and prosperity in the United States. His article in this issue is the first of a group of three, the scope and interest of the following portions being admirably outlined in his concluding paragraph.—The Editors.

IF we trace to its source the change of political attitude in the United States from the time of the formation of the Republic down to the beginning of this century, we find the general tendency of the situation well characterized by the following words of Woodrow Wilson: "The most striking fact about the actual organization of modern society is that the most conspicuous, the most readily wielded, and the most formidable power is not the power of government, but the power of capital." If we compare what the founders of the Commonwealth once intended through the establishment of a democratic *régime*, to attain for the American people (partaking, as it were, in addition to the natural beneficence of a vast country, the benign influence of good laws under a free government) with the distribution of wealth, of power, of opportunity, and even of rights, as it obtains today, under the same *régime*—then it is evident that there must have been some error in the interpretation if the Constitution committed, or some flaw in its articles utilized by the succeeding generations, which has enabled a small but artful minority of the Commonwealth to gain control.

This departure from recognized political principles—equal opportunity and rights for all—was the natural outcome of the observance, in the States, of the French doctrine, "*laissez faire . . . pas trop gouverner*," a precept of political economy advanced by the school of extreme individualism, which was so strong in the latter part of the eighteenth century that even in America it led, ultimately, to the enthroning of commerce over government. As a further result, and one of grave consequence for the Commonwealth, it led to the gradual absorption of public property by private enterprise, a large part of the rich natural resources of the land being turned over to wealthy individuals and combinations of rich men. There was at that time a prevalent belief in America—and in some quarters it is still active today—that the vast area of vacant country in the west and south would never be of any value to the Nation, unless it was exploited and utilized for the benefit of all. So what the country needed in those days, and what it obtained, was the rash work of pioneers, and American enterprise has had an affinity for it ever since.

Pausing, for a moment, to compare potentiality and productivity, or rate of utilization, as it obtains in the States with what obtains abroad, we note, at once, the primitive cause, underlying that spirit of boundless energy coupled with the strong desire for immediate profit; we understand that lack of forethought and want of durability, that tearing down and rebuilding on a new scale, which is as peculiar to American enterprise as it is astounding to the foreign observer. Because, in the old countries of Europe, by the weight of ages and by the sheer force of necessity, by the scarcity of resources and by the pressure of want, youthful enthusiasm has slowly but surely settled back into the channels of carefully devised plans and diligently directed effort, spasmodic and disconnected impulses have given way to a scientific national administration of the factors of production; extreme individualism has been replaced by an organic system of political economy, which is dedicated to the attainment of permanence of success rather than of immediacy, of quality of output rather than of tonnage, of preservation of the whole rather than of benefit to the few.

But in the United States, with its boundless resources, there was in those early days no apparent necessity for the Government to apply the rules of sound business to the affairs of the community at large, and so rights and resources and untold treasures were then given away with a lavish hand. We need only think of the vast stretches of land turned over to the railroads, and of the changing attitude of the latter—from pioneers to dictators—in order to realize that the granting of land privileges, not to speak of the right of the taxing power for private gain, and the evolution of technical progıess—helpful though they were in building up the country and its industries—have led to the construction of that perilous machine which, in the course of time, has become the ruling power in the American Commonwealth.

> "The belief is common in America," says Charles Francis Adams, "that the day is at hand when corporations far greater than ever—swaying such power as has never in the world's history been trusted in the hands of mere private citizens, controlled by single men—or by combinations of men—after having created a system of quiet but irrepressible corruption, will ultimately succeed in directing government itself." (Chapters on Erie, 1871.)

Since that time we have had ample opportunity to observe how the power of capital, by directing the activities of government in city, State and Nation, is at work undermining the country's economic foundations. As a matter of fact, there never was in the history of the world, as far as we know it, a better opportunity open for capital to exploit and exhaust at a rapid rate the irreplaceable treasures of the earth, than is rendered today by modern machinery; and, surely, in no age was technical talent utilized to so large an extent for strengthening the bulwark of plutocracy as it is in our age.

In order to lay bare the foundations of private monopoly power in America it will be necessary to dwell shortly on the constitutional principles which were devised with a view to reserve to the American people the possession of and rights to the public lands, including resources; and in connection therewith, to discuss briefly the various measures which were enacted in later years with a view of playing these public lands into the hands of private corporations. Article IV, Section III of the Constitution, treating of the power of Congress over public lands, contains the following clause:

> The Congress shall have power to dispose of and make all needful rules and regulations respecting the territory or other property belonging to the United States, and nothing in this constitution shall be so construed as to prejudice any claims of the United States or of any particular State.

While, in accordance with this clause, land was sold in the early days of the Republic to the highest bidder, this policy was changed later, by the enactment of the "Preemption Law," by which the nominal price was fixed at $1.25 per acre, no permanent settlement or residence of the purchaser on the land being required. The following "Homestead Law" enabled a man to take up 160 acres of public land and, by residing upon and improving it for five years, to acquire title without other cost than a small fee. The object of this law was, of course, to facilitate settlement and create homes, and in its original form it probably had that effect. But the "Commutation Clause" of the Homestead Law, which was enacted a few years later, defeated its very purpose and brought special privilege to wealthy corporations, providing that after a residence upon a homestead claim of fourteen months the entryman may, by the payment of $1.25 an acre, secure immediate title to his land. Says G. E. Mitchell:—

> Under this law hundreds of thousands of acres of the best of the Government's lands of the West have been entered with but a mere semblance of improvement and settlement, commuted to cash, and transferred to speculators and syndicates, the entryman receiving a small bonus for the exercise of his right.

Thus through a modification of the original law, enacted under the disguise of promoting settlement, the public lands with all their inherent resources were largely brought into the hands of mortgage and loan companies, who are holding title to them now. But this was only the first step of capital in the direction of defrauding Government and disowning the following generations of their birthright.

A second move was instigated by the enactment of the "Desert Land Law." Its official purpose was to encourage the settlement of desert lands by enabling a man to enter 640 acres of such land, and upon irrigating a portion of it and paying $1.25 an acre, to secure title thereto. Its real purpose was, apparently, to assist speculators and other large holders to get control of land and water on the public domain by indefensible means. Quoting the above-named authority:

> This law has likewise been flagrantly abused and vast areas of rich lands, many of them absolutely non-desert, have been entered, patent secured from the Government and immediately transferred by the entryman to some live-stock syndicate or speculative corporation. In several of the grazing States tracts can be seen to-day of 10,000 or 20,000 acres, or even greater areas of contiguous land, acquired from the Government under the desert land law, but which have never been settled upon, and never been irrigated.

Yet this law is still in force, except that its unit has been reduced to 320 acres. (The much quoted "Carey Land Law" enacted in 1894 does not provide for any dealing by individuals with the United States Government. It provides only for transactions between the general Government and State Governments. In order to aid in the reclamation of desert lands and their sale in small tracts to actual settlers, such lands may be patented by the desert-land States, not exceeding 1,000,000 acres to each State, on condition that the State cause them to be irrigated, reclaimed, and operated, and that not less than 20 acres of each 160-acre tract sold be thoroughly cultivated within ten years.)

Another act serving to strengthen plutocratic interests was passed by Congress under the name of "Timber and Stone Law." It was supposed to be for the benefit of the individual home seeker or settler, in that it allowed him to buy from the Government, for his own use, 160 acres of timber land at $2.50 an acre:

> This law has probably been even more flagrantly abused than any of the public-land-acquiring laws. Under it entire train loads of people—Eastern school teachers—have been transported by lumber syndicates into the finest timber regions of the West, and furnished the money to buy, each his 160 acres, and then immediately transfer it to the syndicate.

Vast tracts of land worth, according to Government agents, $100 an acre, have thus been sold by the Government for $2.50 an acre.

Mention must finally be made of the "Coal Land Law," which, though officially limiting individual entry to 160 acres, has, by fraudulent interpretation and the manipulation of dummy entrymen, enabled private interests to acquire holdings of lignite and coal lands, under other than their rightful classification, aggregating something like 30,000,000 acres. No constitutional provisions having been made by the founders of the Republic with the view of reserving to the Government title to the more important minerals of the land, all latent values hidden in the ground, which at any time in the future may be made available by the progress of technical science, are thus forever placed in the hands of private interests and therefore in the grip of monopoly. For where concentration is possible, competition becomes impossible.

Of course, in former years the disastrous effects of the above-named laws were hardly felt. But since the country is populated and consumers are in need of raw materials and of the products thereof, and since markets have sprung up and demands have been created, the supply of these commodities is controlled and restricted by private monopoly powers, and no alternative to unsatisfactory dealing is left available. As conditions appear at present, the American people are forced to pay a premium to enterprising corporations which were far-seeing enough to establish monopolies on practically all the necessities of life, and now derive special profits from those same lands which were once the common property of all. It seems unfortunate to the impartial observer of American conditions that the people have not been able so far, through the suggestion of their Chief Executive, to move Congress to repeal or, at least, to amend those laws, which have been admittedly so detrimental to the first principle of democracy—equal opportunity and right for all.

Though there is still a seemingly enormous stretch of land—amounting to about 700,000,000 acres—titled as property of the United States, it is seen upon careful investigation that a very large part of that area is desert land, having practically no value whatsoever, being unfit for farming as well as for industrial pursuits. As regards the mineral lands, by far the largest percentage has undoubtedly passed into the hands of private corporations, their holdings of coal lands aggregating probably not less than 30,000,000 acres, while of the available water power 33 per cent (and not the worst situated) is already controlled by private interests.

It is only by studying the potentiality of output of the land that we can gain an approximate idea of the extent to which monopoly owns and is exhausting the soil of the United States. Leaving aside farm products and confining ourselves to minerals and metals only, we find that in the production of most of these materials the United States excels all other countries in quantity of output, producing in 1907: 428.8 million tons of coal, 166.0 million barrels of petroleum, 25.7 million tons of pig iron, 23.3 million tons of steel, 868.9 million pounds of copper, etc. Coal, iron, and petroleum being the three principal factors of the mineral production—those most easily lifted, those saleable on all markets without further improvement, and those most urgently needed in industrial pursuits—it is obvious that private monopoly should have endeavored to possess itself of these resources in due time. Hence we have coal, steel, and oil trusts.

But it is equally obvious that Government, being the trust of the people, and having to fulfil those high functions of restraint and service which private initiative cannot or will not perform, must in time awaken to the realization of the fact that these minerals and fuels are irreplaceable public necessities, carrying hidden priceless treasures of tangible value, which even a rich country like the United States cannot forever afford to throw away. Even if we have outgrown today the old physiocratic belief that the soil is *la seule source de richesse*, we know that he who controls the land and its resources controls also the people inhabiting it. Political prudence, therefore, suggests that control of this fundamental factor of production sooner or later be placed in the hands of the community as a whole.

Of course, there are some earnest and patriotic men in the United States who maintain that national ownership or supervision of the production of public utilities would be inferior, even, all points considered, to exploitation by private enterprise. Private ownership, they say, beside having the beneficial effect of building up the country and its industries, is superior in economic as well as in productive efficiency. Being more progressive and financially more successful than the other expedient, private enterprise brings more revenue to the Government and is able also to pay a higher rate of compensation to labor. Moreover—this is the political argument—owing to the fact that nationalization of public utilities will create a large number of employees and officials, it is objected that such a class would be more or less dependent on political favoritism, being a willing tool for either the one or the other party that might be in power. Finally, it is argued that the rule of monopoly means in the United States the absence of any other adequate rule. The power of Federal and State governments having been weakened, at the foundation of the Republic, by an artificial system of checks and limitations, the Administration today possesses neither the austerity nor the competency to be entrusted with the exploitation of the country's resources. The result of State or national Government ownership and management, they say, beside increasing cost of production, would be to enable the unintelligent, by a majority vote, to enforce an instant lowering of the price of these commodities. But this temporary advantage, great as it may seem, would soon result in wasteful consumption and be followed later by exhaustion and famine prices. Private monopoly, according to the idea of these men, is therefore a natural corrective of the absence of paternal government. It is a result and a cause at the same time. If, then, monopoly gets its grip on one of the great natural resources of the land and charges twice as much for a commodity as it would cost under a competitive *régime,* the trust is, after all, the good angel saving the people from themselves, and protecting the country from that feverish inclination for waste and destruction which seems an unavoidable adjunct to "unlimited opportunities."

> If our ability to exhaust and destroy were commensurate with our proclivities, the United States would before now have become an emptied shell. (Harrington Emerson.)

Summing up, I have given in the above a short *résumé* of the history of public lands and resources in the United States and of their transference, through the power of capital, to private hands, together with a fair presentation of the arguments which are advanced by the moneyed interests in favor of private ownership and exploitation. In the following I shall attempt to show what influence the uneven distribution of the two principal production factors, nature and capital, and the overruling power of the latter, have on the third factor of labor; what influence emancipation and concentration of capital has especially on technical talent and productivity, which is the root of all progress. And, after having proven that such influence is harmful to national efficiency, I will show in detail what measures the executive circles of other countries (laboring, of course, under somewhat different conditions) have devised for preventing as far as possible the evils of private monopoly.

THE TWELVE PRINCIPLES OF EFFICIENCY.

By Harrington T. Emerson.

VIII. THE SIXTH PRINCIPLE: RELIABLE, IMMEDIATE, ADEQUATE, AND PERMANENT RECORDS.

Since our last issue went to press, efficiency engineering has become a national issue in the United States. Its immediate importance in connection with pending questions of railroad finance and economics is further emphasized in Mr. Emerson's article this month. This chapter—both by current associations and intrinsic quality—will be found one of the most engrossing of the series.—The Editors.

WHEN a child touches the red-hot end of a poker, the information, advice, notice, record is reliable and lasting, also immediate and adequate. The scar is a perennial reminder of the mistake. Many of Nature's warnings are reliable, immediate, and permanent; they reach us and other animals through the senses—we hear, we see, we smell, we taste, we feel. Very few people allow themselves to be burned, because the penalty is reliable, immediate, and adequate; but they are not as shy about more deadly disease germs (probably a thousand people die of tuberculosis for one who is burned to death) because the result is not reliable nor immediate.

The object of records is to increase the scope and number of warnings, to give us more information than is usually received immediately through our senses. A steam boiler with water in it, a fire under it, and all outlets closed, is more dangerous than a hot poker. There is very little to indicate the imminence of disaster. It is too hot to touch with the hand, although it is conceivable that a spot in it might be so insulated as to permit the engineer to tell by feeling whether it was becoming too warm. A thermometer would give a better record; but usually there are three recording instruments, each reliable and immediate, one of them in addition adequate. The engineer watches his pressure gauge, he watches his water level glass, and the safety valve will pop even if he has fallen asleep. It is because of these three devices, one of which is independent of the man, that there are so few boiler explosions. All around us are many natural forms of advice, *of records*—the word is throughout used in its largest sense.

The object of records is to annihilate time, to bring back the past, to look into the future, to annihilate space, to condense a whole railroad system into a single line, to magnify the thousandth part of an inch to foot-rule measurement, to gauge the velocity of a distant star by the shifting of the lines in the spectroscope, to annihilate temperature by enabling us to read the millionth of degree or the 10,000-degree difference between moon and sun heat.

Animals make and use records, reach out to each other through time and space; and the naïve surprise of the doe when the stag appears does as much credit to her modesty as the trail of musk left in her footsteps along many miles and for many days does credit to her involuntary common sense. Man alone reaches out to man through millenniums; and the pictures carved in stone, the hieroglyphics pressed in brick or cut in granite, tell us more about the intimate lives and philosophies of the Egyptians, of the Hittites, than we know of our own immediate ancestors, the Germans or the Gauls—than we know of our immediate neighbors, the Indians. Pictures and writing were a great invention; the reducing of music to written form so it could be reproduced was even more marvelous, since through the eye we recreate for the ears, thus bridging the gap between the senses. The perpetuation of sound through ages in the phonograph disk, the perpetuation of movement on a long film, these are part of man's triumph through records. The phonograph disk is, next to the brain, the most marvelous if not the most useful record man possesses, since all the throbs, moans, triumphs, all the *nuances* of a hundred instruments and of a hundred voices, pulsations of the air, are recorded by the needle point in a microscopic line; and that line, that perfect record, gives us again the same air pulsations, the same great instrumental and vocal chorus.

The efficiency engineer places himself on the apex of a hyperboloid, and by concentric rings around and below him he makes himself all powerful, all safe. His hyperboloid is staff organization; the other hyperboloid is line organization; but in the staff there are the ring of idealists, the rings of judicious plans, of competent advisers, of disciplinarians, of fair dealers, of records, of minute knowledge, of execution, of perfected conditions, of perfected operations, of stimulated co-operation.

Records are anything that give information. Men have always felt the need of records but they have not always known what they wanted nor how to secure them. In the great industrial plants one knows not whether to marvel most at the absence of reliable, immediate, and accurate records, or at the superabundance of permanent records, collected with painstaking and at great expense, but neither reliable, immediate, nor adequate. Even if the latter have all these qualities, there is often great duplication, and as a consequence we find an immense amount of accumulation of very little value, which has cost far more than it need. An example of duplication may be found in the coal records for locomotives. Expenses of operating locomotives are generally recorded per mile, but suddenly a parallel set will crop up showing miles run per ton of coal. It has not been unusual in a great corporation's records to find a great variety of monthly tabulations, and when inquiry is made it is finally unravelled that twenty years before some president wanted a certain set of records, that his successor wanted a different set, which were started in parallel, that a third and fourth incumbent added their requests, but the old tabulations continue to be made and painstaking clerks work their monotonous lives away in neat compilation that no one has looked at, much less used, for a decade.

When the tramp piled and repiled the same cord of wood first on one side of the yard, then on the other, he was working efficiently but to no purpose; and having the soul of an artist he finally rebelled.

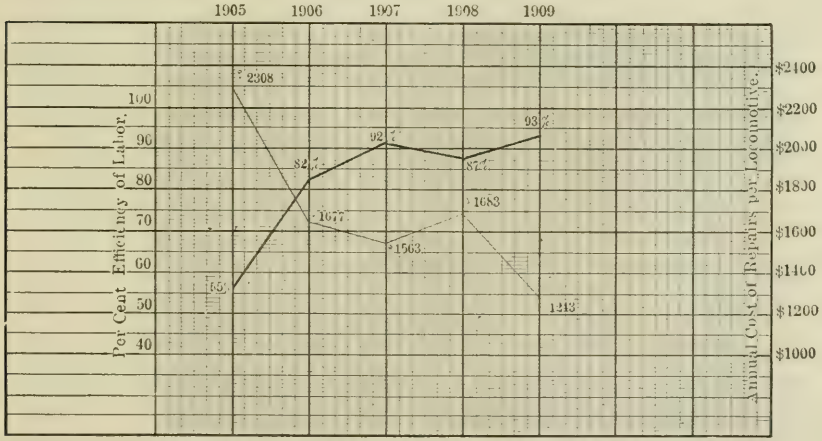
A clerical force may be hard at work, but it may accomplish very little and in the larger acceptance of the word it is inefficient, even as a hard-working steam engine using 50 pounds of steam per horsepower hour is inefficient in spite of its diligent consumption of coal.

There are records of all kinds, many of them essential to our continued existence. There are in a much more limited way records of cost; and between the two extremes of universal records (as the swing of the earth in its seasons or the slow aging of every living and inanimate thing) on the one side, and cost records on the other, come records of efficiency, and these are what we particularly need in the present phase of industrial life. We have not yet learned to use to any great extent the conception of efficiency. We are interested in what eggs cost per dozen, not in the weight of each egg; we ask the price of coal per ton, but rarely know whether it contains 10,000 or 15,000 heat units per pound; we violently resist a demand for a 10 per cent increase in wages, but we tolerate a 50 per cent inefficiency in the worker. Not one in ten thousand knows even approximately the cost of food. Its price is known, but not its value, and if a curve of food values per pound should be drawn, and above each item its price, the line would look like the record of the seismograph during an earthquake, or the record of a magnetic needle during an eruption on the sun.

The whole United States was frantic in 1896 over the money question, and not one in a thousand of the gold advocates knew that owing to violent fluctuations in supply and use gold had varied in value more than any other staple, not from hour to hour, as gold bonds and gold stocks fluctuate in value on the stock exchange, but from decade to decade. One of the tasks of modern scientific management, of efficiency and standard-practice engineering—two names for the same ideals—is to convert efficiency records into cost records, since the language of costs is understood by all, the language of efficiency only by the few. It is, of course, generally true that costs will decline as efficiency increases, but this is not always so.

A jeweller may work with the same efficiency setting on one day a $2,500 diamond in a gold stickpin and the next day setting a $0.25 bit of glass in a brass pin. Costs have varied, but not efficiency. A Japanese miner may work for $0.20 a day and an Alaskan miner for $15.00 a day. Each may work with equal efficiency, but the cost is very different. On the other hand, a farmer from the same field, planted to the same crop, plowed by the same man, team, and plow, raises increasing crops of the same grain; but wages, land values, and the price of horse feed might also increase so that decreased cost will not always directly flow from increased efficiency.

Efficiency of Labor and Cost of Locomotive Repairs.



Average wgt. of locos.	75.63	79.50	81.74	82.98	82.98
Mileage per loco. failure.	3160.	4900.	4250.	4641.	6200.
Tonnage hauled per loco. mi.	685.	725.	765.	770.	796.

The Engineering Magazine

RECORD OF EFFICIENCY AND COSTS IN LOCOMOTIVE REPAIRS.

In the refinement essential for the control of modern operations, it becomes increasingly necessary to state efficiencies even if we talk costs.

As a contribution to the solution of this problem a universal formula of cost and efficiency has been evolved which has the further advantage of showing what records are really essential and necessary, what form they ought to take and what records are useless, confusing, and to be omitted. All the necessary reliable, immediate, adequate, and permanent records can be obtained and maintained for less expense than is usually incurred for misleading, delayed, inefficient, and ephemeral records.

The costs of modern operations consist of three elements. For instance, it may have cost in a recent year to operate all the railroads of the United States approximately:

For materials..................................	$ 540,000,000
For personal services............................	1,035,000,000
For interest, depreciation, and other capital charges..	1,000,000,000
	$2,575,000,000

Omitting millions, we can set up the formula:

$$\begin{array}{ccccccc} \text{Total cost} & = & \text{Materials} & + & \text{Personal service} & + & \text{Investment charges.} \\ \$2{,}575 & = & \$540 & + & \$1{,}035 & + & \$1{,}000 \\ \text{C (actual)} & = & \text{M(actual)} & + & \text{S (actual)} & + & \text{I (actual)} \end{array}$$

Let us assume that extended investigations would show very inefficient use of materials, very inefficient use of personal services and over-equipment, and that from a practical point of view it might be possible to state that the same general result could be accomplished with $370 of materials, $780 of personal service, and $600 of investment charges.* The formula of standard cost then becomes:

$$\begin{array}{ccccccc} \text{C (standard)} & = & \text{M (standard)} & + & \text{S (standard)} & + & \text{I (standard)} \\ \$1{,}750 & = & \$370 & + & \$780 & + & \$600 \end{array}$$

The efficiency of the whole operation is:

$$\frac{\text{C standard}}{\text{C actual}} = \frac{\$1{,}750}{\$2{,}575} = 68.9 \text{ per cent.} = \text{Total efficiency} = \text{E}$$

The relation of standard cost to actual cost gives the efficiency. This can be applied to each sub-part:—

$$\frac{\text{Material cost standard}}{\text{Material cost actual}} = \frac{\$370}{\$540} = 86.5 \text{ per cent.} = \text{Material Efficiency}$$

$$\frac{\text{Labor cost standard}}{\text{Labor cost actual}} = \frac{\$\ 780}{\$1{,}035} = 75.3 \text{ per cent.} = \text{Service Efficiency}$$

$$\frac{\text{Investment cost standard}}{\text{Investment cost actual}} = \frac{\$1{,}000}{\$\ 600} = 66.7 \text{ per cent.} = \text{Investment Efficiency}$$

---

* These figures are used only for illustration, not as the expression of a conviction. The author will shortly publish a monograph on the subject of railroad costs.

Actual costs can next be stated in terms of standard cost and of efficiency:—

$$\text{Total actual cost} = \frac{\text{Total standard cost}}{\text{Total efficiency}} = \frac{\$1{,}750}{68.5\%} = \$2{,}575$$

$$\text{Total actual cost} = \frac{\begin{array}{c}\text{Standard cost}\\ \text{of material}\end{array}}{\text{Material efficy.}} + \frac{\begin{array}{c}\text{Standard cost}\\ \text{of service}\end{array}}{\text{Service efficy.}} + \frac{\begin{array}{c}\text{Standard cost}\\ \text{of investment}\end{array}}{\text{Investment efficy.}}$$

$$\text{Total actual cost} = \frac{\$370}{68.5\%} + \frac{\$780}{75.3\%} + \frac{\$600}{66.7\%} = \$2{,}575$$

If we know in advance the standard or theoretical costs, if we know the current efficiencies, we can predetermine actual costs. What we all desire is to make the industrial machine as efficient as possible, to bring efficiencies up to 100 per cent, and when we do this actual costs will be the same as theoretical costs. We must first attack the problem theoretically. We must have standards and we must have efficiencies. When a pump or steam engine is tested, by every means we ascertain ideals; we then compare actualities with the ideals and we ascertain efficiencies. Similarly, in the great industrial problem we set up ideals, we measure against them actual performance, and we ascertain efficiencies, and as for pumps and for steam engines, so also do we use these efficiencies to prophesy future costs.

When actual and ideal performances are both recorded the relation in one month will generally serve to predetermine efficiencies in the next month; the relation of one year will generally serve to predeterimne efficiencies in the next year.

The elementary formula is, however, wholly inadequate for a real determination of efficiencies and has in fact led to most serious misconceptions and consequent mistakes.

Reference has already been made to the folly of the man who buys coal by the ton without knowing whether it contains 10,000 or 15,000 heat units per pound, who scrutinizes the cost of personal service without knowing its quality, who invests in new machinery without counting its hourly cost.

The cost of materials depends on two factors, the quantity and the price.

$$\text{Material costs} = \text{Quantity of units at price per unit.}$$
$$M_c = Q_m \; P_m$$

Very often a higher price will lessen the quantity, and it is evident that what is wanted is that $Q \; P$ shall be a minimum cost.

In considering materials it becomes necessary to determine the efficiencies of both quantity and price.

$$\text{Materials actual} = \frac{Q_{st}\ P_{st}}{E_{mq}\ E_{mp}}$$

What is true of materials is equally true of personal service. Labor, like material, consists of both quantity and quality. The quantity of labor is measured by time, its quality by what it accomplishes. We do not measure the value of a musician by the number of notes he has struck—he may have been playing *largo;* but we do measure him by the time he plays and by the beauty of his performance.

The formula for personal service becomes

S = time in hours multiplied by wages per hour.
$S = T\ W$

As in materials, so in personal service, it is the proof of advancing civilization that the efficiency of T increases more rapidly than the efficiency of W. If it were not so there would be no inducement to advance W, there would be nothing over for the community. The locomotive engineer is paid higher wages than the Chinese coolie; the latter carries 150 pounds 20 miles in a day; the former hauls 6,000 tons 60 miles in a day; but the wages are not in proportion. Therefore piece work is necessarily wrong, since it gives a man all the gain due to his increased efficiency when he is only entitled to a large part, not to the whole.

T cannot indefinitely decrease, neither can W indefinitely increase, and experimentally we must determine what combination of T W results in minimum cost.*

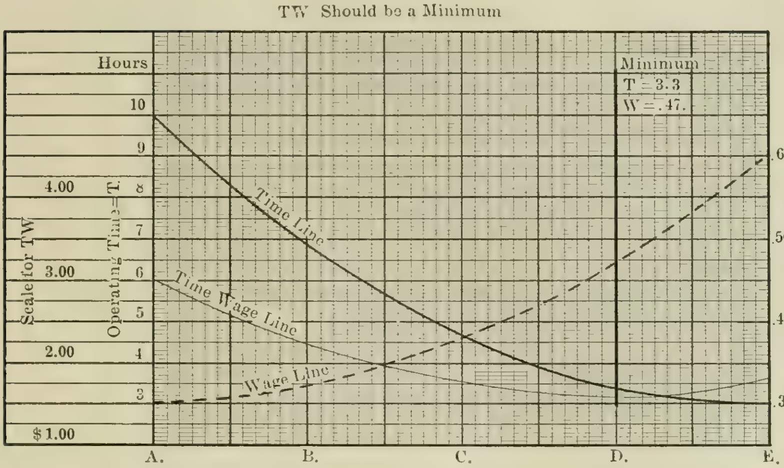
$$\text{Actual service cost} = \frac{T_{st}\ W_{st}}{E_t\ E_w}$$

Evidently an American at $0.50 an hour doing a given task in one hour is better than a Mexican taking four hours at $0.15 an hour. As T has so much more influence than W, it is of the first importance to make motion studies and time determinations as to every item of work, and, provisionally accepting current wages experimentally determined, to increase wages rationally as T falls off, even as locomotive engineers receive far more per hour than does the man with the hod or with the wheelbarrow.

What is true of materials and of personal service is equally true

---

* This relation at varying rates of time used and wages per hour is exhibited on the efficiency diagram opposite.



TW.	T.	W.	Total.
A	10.00	.30	$ 3.00
B	6.85	.32	$ 2.192
C	4.60	.38	$ 1.748
D	3.30	.47	$ 1.551 Minimum
E	3.00	.60	$ 1.80

The Engineering Magazine

EFFICIENCY DIAGRAM SHOWING RESULTS AT VARYING COMBINATIONS OF TIME USED AND WAGES PER HOUR.

of investment charges. Investment charges, like personal service, fall into *time* for any performance and the cost *per hour.*

$$I = T' R$$

in which T′ indicates time in hours and R cost per hour for capital charges.

If all the railroads of the United States are worth $14,000,000,000, it is evident that the annual capital charge for interest, depreciation, insurance and taxes might be $1,000,000,000—that the actual capital charge per hour is $114,155. If, therefore, as a token of respect to the memory of a dead president, all railroads should stop operations for 10 minutes at the time of his funeral, the cost would be about $20,000 in decreased efficiency of R, but the officials would hasten to make it up by increasing the output of the subsequent hours, thereby raising the efficiency of T′.

As for materials and for service, so also we must determine which T′ and R in combination result in the least cost.

In pay for services, the natural law is that an increase ought to decrease *time* in larger proportion, but in equipment it is very common to increase R unwisely and very greatly for a less decrease in T′. The same law prevails for equipment as for materials and labor. Additions to equipment should decrease, not increase, costs.

$$\text{Actual investment cost} = \frac{T'_{st}\ R_{st}}{E_{t'}\ E_r}$$

This relation of rate per hour to time is generally lost sight of. It is because it has been lost sight of that over-equipment is the rule in America.

Through materials, service and equipment we have worked up to the general cost formula.

$$\begin{aligned}\text{Total cost} &= \text{Materials} + \text{Service} + \text{Investment charges.}\\ \text{Total cost} &= \quad Q\,P \quad + \quad T\,W \quad + \quad T'\,R\end{aligned}$$

Usually only the greatest of industrial managers realize that $\underset{\sim}{Q}$ is more important than P; that T is more important than W, that R is more important than T′, and that minimum total cost is realized when $\underset{\sim}{Q}$ P is minimum, T W the minimum, and T′ R the minimum.

For all the operations or for any single unit

$$\text{Total actual cost} = \frac{\underset{\sim}{Q}_{st}\ P_{st}}{E_q\ E_p} + \frac{T_{st}\ W_{st}}{E_t\ E_w} + \frac{T'_{st}\ R_{st}}{E_{t'}\ E_r}$$

This formula shows what records are wanted, namely, the six items of standard cost and the six items of corresponding efficiencies. No manager, no accountant, knows where he stands unless his records show him as to every operation:

The standard quantity of material
The efficiency of material use
The standard price of material unit
The efficiency of price
The standard quantity of time units required
The efficiency of time
The standard rate of wages for work of the character done
The efficiency of wage rate
The standard quantity of time for equipment
The efficiency of time use of equipment
The standard equipment rate per hour
The efficiency of equipment use

The formula is equally applicable to a totalized operation costing one mill as the page of a periodical, or to the operation of all the railroads of the United States as one great unit.

Records as to each detail, aggregated into records as to the whole, are one of the efficiency principles; records as to each item and every item today, records as to each and all items throughout a long period of time. He who has records of quantity and price—efficiencies of both, of every unit of material used, whether ton of rails or pint of oil; who has records as to time and wage rate for every operation, and the efficiencies; who has records as to time and investment charge per hour for every operation—he is in a position to apply the other practical principles and thus bring actual up to ideal. Records of this kind are simpler, cost less to keep up, than the usual industrial and cost records of great companies.

Cost accounting can be very simply and easily developed from the cost formula. The elaboration would carry us too far from the subject of records, reliable, immediate, adequate and permanent.

In a periodical publication as to each page there is material, personal service, equipment charge; and if the weekly edition runs to 2,000,000 copies of 80 pages each, a saving of the one one-hundred-thousandth part of a cent in cost per page means $800 in a year, enough to leave some profit after paying the salary of a man whose sole duty might be to prevent this minute waste.

When the formula is applied to railroad operating cost it inevitably shows that E is low. We have all seen locomotive safety valves popping and black smoke issuing from stacks. There is waste of fuel, but fuel is the largest single material item in railroad operation, amounting in fact to one-third of all material expense. We have all seen railroad day laborers dawdling over their work; but common labor, notoriously of poor efficiency, is the largest service item in railroad operation, being about one-eighth of the whole. We have all seen superfluous equipment, whole roads parallelled; and even if there were not an item of duplication, is it not conceivable that with a complete understanding of the problems by people, by government and by managers, railroads might secure money at 4 per cent instead of 6 per cent, thus reducing equipment interest charges $280,000,000* a year? By the test of the cost formula we can at least analyze every item of expense, determine standards and efficiencies, and strive for waste elimination. The cost formula is one of the instruments wherewith wastes can be detected and measured; but even as Kepler proved by measurement that all planets moved in elliptical orbits, so does the proper measurement of costs show where the savings, if made, must necessarily go.

---

* This item was not included in the recent estimate of a preventable railway operating loss of $1,000,000 a day.

The savage destroys, the barbarian squanders, but the civilized man conserves. Q P therefore measures civilization, T W measures civilization, T′ R measures civilization. There is scarcely a conceivable limit to quality, but quantity, natural resources, are limited; there is scarcely a conceivable limit to human skill; but each individual's span of time is inexorably limited. Friction and clumsiness, duplication and waste, can be eliminated from equipment; but each machine's life is limited. As to material, shall we use radium or shall we use sulphur; as to equipment, shall we use the old round blunderbuss bullet or shall we use the slim modern pointed bullet which travels twice as fast, goes four times as far, and weighs half as much; as to equipment, shall we use subways built with 4 per cent money advanced by the city, or shall we travel on slow surface cars drawn by horses and earning 10 per cent? As to equipment, shall we use the king's couriers on the king's highway or shall we use the telephone over a 1,000-mile gap? Shall the workers idle the long days through and be content with yams and a gee string?

Civilization is high when Q P is low; civilization is high in which T′ R is low; but reductions in Q P, reduction in T′ R must be balanced by increases in T W. Records, the instruments by which these relations are discovered and determined, are not dry and monotonous; they are an inspiration and a guide.

This is the final problem:—

Shall ultimately more of us work less time each, W remaining low, or shall we all work a reasonable time and greatly increase W? Having increased our command over materials, over equipment, what shall we do with the gain? I once heard an eloquent labor-union leader expound his creed: "Eight hours for work, eight hours for play; eight hours for sleep, and eight dollars a day." Eight hours for sleep—yes; eight hours for work—why not more or less as we find pleasure and delight or aversion and pain in it? A dollar an hour! Why not what we are entitled to through elimination of material and equipment wastes? Eight hours for play? There are moments in a man's existence that count more than monotonous months —the moment when Charles the Hammer learned that the Saracens were in rout; the moment when Columbus learned that land was lifting to westward; the moment when Lister conceived of asepsis, when Pasteur conceived the germ theory. Many of the minutes of the eight hours for play can be expanded into moments worth while, through the conquest of matter and of time.

> Gebraucht der Zeit, sie geht so schnell von hinnen.
> Doch Ordnung lehrt Euch Zeit gewinnen!
>
> —*Goethe.*

ILLUMINATION BY ALBA FLAMING ARC LAMPS, COLOGNE, GERMANY.

THE NEW ERA IN ELECTRICAL ILLUMINATION.

By Rollin W. Hutchinson, Jr.

II. FLAMING, LUMINOUS-ARC AND VAPOR LAMPS.

In the introduction to Mr. Hutchinson's first article, in our December issue, we called attention to the point that he has in view service to the *user* rather than the *manufacturer* of illumination. This is, of course, a service of far wider applicaion than the other, manufacturers generally being ably advised by specialists on their own staff, while not only individual users but the industry at large may profit from an impartial, well-informed review of comparative service characteristics and costs. Mr. Hutchinson's former paper discussed metal-filament lamps. It was expected to complete the review in this issue, but the magnitude of the work compels division into three parts, and the section on vapor lamps will be published in February.—THE EDITORS.

THE flaming or luminous-arc lamp is the invention principally of H. Bremer, who first placed a commercial "yellow arc lamp" on the market in 1899. Like nearly all important inventions, the flaming arc also had forerunners, and its history is a gradual evolution from the experiments of Casselman, in 1844, who suggested the employment of the salts of copper, strontium and zinc in the carbon electrodes of arc lamps to modify their color. His experiments were continued by French chemists, notably by Carré and Archereau in France.

The electrodes of flaming-arc lamps consist of carbons to which mineral substances are added, chiefly fluorides of alkaline minerals which cause the arc or vapor stream to be extended to considerable length and at the same time to become luminous, increasing thereby the luminosity of the light. In the ordinary enclosed carbon

STREET ILLUMINATION BY 4-AMPERE LUMINOUS ARC LAMPS, SOUTH MAIN ST., SALT LAKE CITY.
Courtesy of the General Electric Co.

arc 95 per cent of the light comes from the incandescent crater of the upper carbon, whereas in the flaming arc 25 to 35 per cent of the light emitted is due to the intensely luminous vapor stream. The salient feature of the Bremer lamp is the arrangement of the electrodes in an inclined position. In the class of superposed-electrode lamps using flaming carbons, so-called luminous arcs, are included magnitite lamps, Blondel lamps, and titanium-carbide lamps, together with carbon lamps using inclined electrodes but not impregnated with metallic salts.

In his experiments with the flaming arc Bremer discovered that the use of the electrodes in a vertical position in the lamp resulted in the formation of a kind of slag deposit on the tips caused by the mineral admixtures, which being non-conductive interfere with the uniform operation of the arc or unsteady it to an objectionable extent. Various means, such as, for instance, the use of water glass or boracic acid in the carbons, were tried to overcome the objectionable effects of the slag, but the only practicable method of overcoming the trouble consists in arranging the carbons in an inclined position with their active ends converging so that no slag will form in the path of the vapor. An additional advantage of the inclined position of the carbons is that nothing can obstruct the light of the arc, as is the case in the vertical-electrode arc.

Two further elements of much importance in flaming arcs are the "economizer" and the "blow magnet." The economizer of the original Bremer lamp consisted of a truncated metallic cone surrounding and supporting a porcelain disk through which the carbons are inserted. Its purpose is to increase the efficiency of the arc by concentrating the heat, and to lengthen the life of the carbons by limiting the air supply. The economizer also acts as a reflector owing to the white deposit of the arc flame settling on it, thus throwing most of the light in a downward plane.

The function of the blow-magnet is to prevent the arc from climbing up and damaging the economizer, particularly when the carbons are nearly burned out. When this occurs the arc is blown away by the magnet, or if necessary, extinguished. The blow-magnet can also be used to spread the shape of the arc as may be desired, preferably, however, into the form of a reversed umbrella. This feature of the blow-magnet makes it possible to increase the diameter of the carbons and thus lengthen the period between trimmings.

In most uses of the flaming arc, however, a blow-magnet is not required since the electric arc is itself a magnetic-field generator and tends to force the arc away from the tips. Under some circumstances, as, for instance, with a 12-ampere flaming arc, it might become necessary to use the blow-magnet to produce a reverse action —that is, draw back the arc toward the carbon tips instead of forcing it away from them.

There are three kinds of flaming-arc carbons in commercial use, yellow, red, and pearl white. The yellow, which is the more extensively used, is produced by the admixture of calcium (lime) salts in the carbon in the form of a core. The red flaming arc, which in practice is more nearly a light pink, is produced by the use of strontium salts. The white color is produced by the use of barium salts. The most efficient of the three is the yellow carbon which is, as stated, the most popular. The illuminating power of the white-flame carbon exceeds but slightly that of the open arc with pure carbons, the red carbon having an intrinsic brilliancy slightly lower than the white.

Efficiency and Illuminating Characteristics of Flaming Arcs.

The intrinsic brilliancy of the flaming arc exceeds that of all other illuminants of the arc variety and its light efficiency is much greater than that of the tungsten lamp. The specific consumption of energy per mean spherical candle power is not over 0.5 watt per candle power ("mean spherical"), which figure exceeds that of the enclosed carbon arc from four to six times, and is also nearly three times less than that of the tungsten lamp.

This high illuminating power is thrown exactly below the center of the lamp, which enables it to be utilized more efficiently for some purposes than is the case with arc lamps having vertically superposed carbons, which emit their maximum light intensity at an angle of 45 degrees below the horizontal. This concentrated illumination feature of the flaming arc is not a desirable quality when such lamps are used for street lighting where the lamps are widely spaced, and it would be decidedly preferable if the light immediately under the lamp had a minimum intensity increasing with the angle from the vertical.

The reason for the high illuminating power below the lamp is that light is not emitted only from the luminous vapor path, but the major portion of the light comes from the incandescent carbon tips. The idea has been prevalent that all the light of the flaming arc is emitted by the luminous vapor, but this is incorrect, as Prof. Wedding has shown that only about one-quarter of the light comes

ILLUMINATION OF THE THIERGARTEN, BERLIN, BY ALBA FLAMING LAMPS.
Courtesy of the Charles L. Kiewert Co.

from the arc flame, the other three-quarters coming from the incandescent carbons. Since most flaming-arc lamps employ an ash receiver, the effect of a maximum light intensity in the downward plane is modified by the obstruction which the receiver offers.

Factors Influencing Economy of Flaming Arc Lamps.

Although as previously stated the intensity of light given by the flaming arc increases with the percentage of the salts added and the specific energy consumption is as low as 0.34 watt per mean spherical candle power with carbons containing 40 per cent of

ILLUMINATION OF THE FOUNDRY OF THE MISSOURI MALLEABLE IRON CO., EAST ST. LOUIS, MO., BY REGENERATIVE ARCS.
Eleven 110-volt direct-current regenerative arcs. Building 666 ft. long by 152 ft. wide.

"fluorspar" salts, nevertheless such a high proportion of metallic salts in the core is not practicable nor conducive to economy because of the excessive formation of slag. The economy of the flaming-arc lamp is also governed by the dimensions of the carbons. The diameter of the carbons is governed both by the kind of lamp and its construction, and is affected also by the kind of blow magnet and economizer used. The diameter must be limited, as has been pointed out, to obviate climbing of the arc. The economy of flaming arcs is hence limited by the length of the carbons, which of course limits their life. Increasing the length of the carbons increases their life and hence reduces the expense of trimming.

The candle power or size of the flaming-arc lamp also governs its economy to a certain extent. Tests have shown that it is more economical to use one large unit than to obtain the same candle power with a number of smaller ones, as the initial expense is greater, and the operating expense is decreased.

Summarizing the practical advantages and disadvantages of the flaming-arc lamp it may be stated that its first and foremost feature is a very high efficiency, exceeding greatly that of any other illuminant on the market. The chief disadvantages are the present high price of the carbons used on account of the high tariff imposed on their importation (nearly all the flaming-arc electrodes come from Germany), the frequent trimming required, the fumes given off, the deposit of ash inside the lamp, and its unsuitability for street lighting, except of a special kind.

PRESENT-DAY FIELD OF SERVICE OF THE FLAMING-ARC LAMP.

In the United States the luminous or flaming arc has been in use only a few years and hence the number of applications which have been made of it are few as compared to its uses in Europe, particularly Germany, where the lamp originated and is widely employed, its extraordinary efficiency appealing greatly to the thrifty Germans.

In Germany the lamp is extensively used for municipal street lighting and fairly satisfactory results are obtained despite its unfavorable light emission for this purpose. The usual practice is to suspend the lamps from cables secured to the walls of houses on opposite sides of the street, the lamps being hung about 30 to 35 feet high in the center of the streets and spaced up to 300 feet apart.

The lighting of squares and plazas is done by mounting three or four lamps about 50 feet high on ornamental poles. In this way the cost of installation is much reduced, as only one pole and one set of cables are needed.

In German practice it is also the rule to use carbons of different lengths depending on the season. Thus in winter when the nights are long the carbons are long, while in summer when the nights are short, their length is reduced. The strong feature of the lamp cutting itself out of service when the carbon is consumed permits it to regulate easily.

In Continental Europe luminous arcs of one type or another dominate the field of outdoor lighting since it has been the experience that the more light produced the more the public demands. For example, where two gas arcs were formerly used, four and occasionally six, flaming arcs are used; and it is no unusual sight to count as many as fifty to seventy-five flaming arcs on one block in Berlin.

The possibilities of increased illumination by the use of the flaming arc have been quickly foreseen by industrial establishments of all kinds both in the United States and abroad, and mills, foundries, machine shops, etc., report increased outputs and higher class of service as a result of its use. The immense volume of light which it produces permits the lamp to be suspended high enough to clear all machinery and yet illuminate the space below with powerful brilliancy.

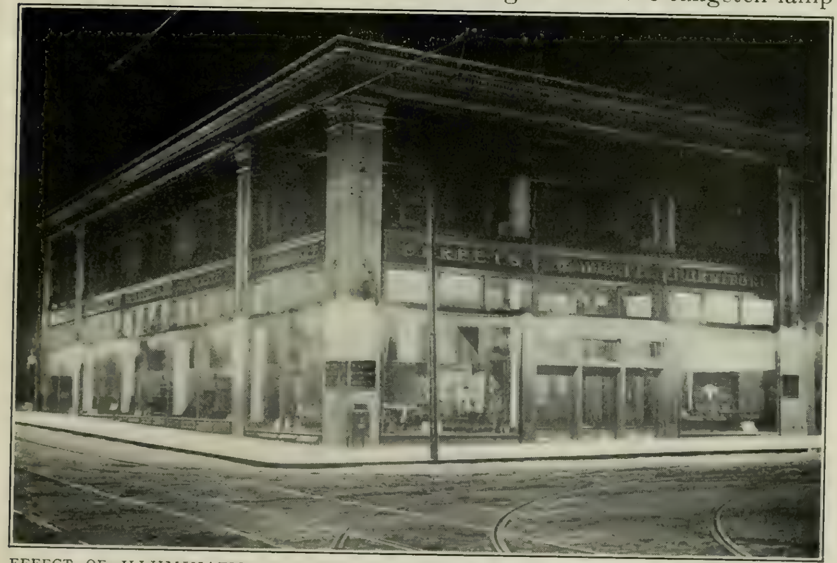
The flaming arc is rapidly monopolizing the field of advertising by electric means. All kinds of amusement enterprises, parks and theatres realize the efficiency of the flaming arc for commanding attention, while the department stores of the large cities frequently utilize as many as fifty lamps of this type in front of their buildings.

Shopkeepers are increasing the brightness of their show-windows by employing flaming arcs and at the same time are decreasing the first cost of lighting as well as operating expenses. For this purpose the lamps are mounted above the window, the ceiling of which is of opalescent glass. In this manner a powerful volume of light is cast in the window, the source of light being concealed. It has been found that when so used the yield of light from a 550-watt flaming arc is equal to that of 2,000 watts in incandescent lamps.

In England the flaming arc has made but little progress but the outlook for its widespread adoption is most favorable. In London the high penetrability of the lamp has been found very serviceable during fogs. The utilization of the flaming arc in France has also been slow, the principal use of the lamp having been made in lighting a few streets in Paris and the larger cities. As is the case in most European countries the most satisfactory lamps in use are of German make.

INFLUENCE OF THE FLAMING ARC IN COMPELLING USE OF TUNGSTEN LAMPS.

For interior illumination, particularly stores, the flaming arc has exercised a peculiar influence in making the use of the tungsten lamp almost compulsory. It is customary for shopkeepers who appreciate the value of the flaming arc as an advertising medium to install one or two of these lamps in front of their stores. The powerful brilliancy of the light causes the pupil of the eye to contract to such a degree that to the observer the illumination of the store appears defective, although in reality it may be excellent both in point of distribution of light and intensity of illumination. So great is the contrast that the storekeeper is obliged to use tungsten lamps in place of the ordinary incandescent lamps, and at the same time use more of them. In those cases where the flaming arc is used for advertising purposes, the shadows in the window are offset by studding the roofs with 60-watt tungsten lamps in mirror reflectors. The intensely brilliant light of both the flaming arc and the tungsten lamp



EFFECT OF ILLUMINATION BY TEN 110-VOLT ALTERNATING-CURRENT REGENERATIVE ARCS.

Building 60 by 90; lamps 10 ft. from sidewalk and 4 ft. from the building.

not only causes the light from the ordinary carbon-filament lamp to appear dim, but also shows up the sickly green light from the gas lamps and finally causes their displacement.

Maintenance Expense of Flaming Arcs.

The increasing use of the flaming arc for street lighting and for industrial-plant illumination makes the question of their maintenance cost as compared with ordinary arcs of great consideration. The energy consumption of the "differential" type of flaming arc is 550-watts, which at an average cost of 2 cents per kilowatt-hour makes the lamp consume $11 of energy per 1,000 hours for current. Taking the net cost of imported flaming-arc carbons, the cost per trim per 1,000 hours, labor included, is $8.50, making the total cost of trim and carbons $19.50 per 1,000 hours. The cost of repairs and globes per 1,000 hours may be estimated at $2, to which must be added interest on the investment, while a depreciation of $2 per 1,000 hours must also be included, which totals $23.50 per 1,000 hours of operation as the maintenance cost. Estimating the average yearly burning as about 4,000 hours the cost would be $94 per year per lamp.

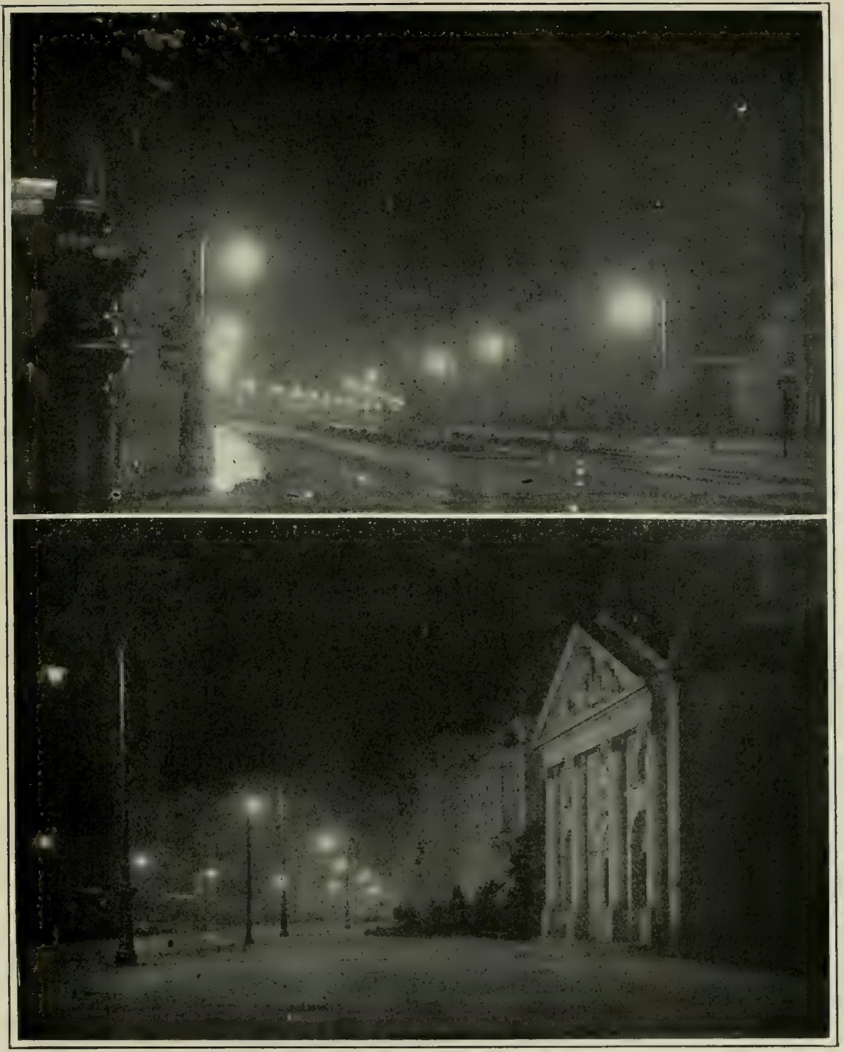
The Magnetite Arc Lamp.

This type of lamp belongs to the luminous arc lamp group and is due chiefly to the investigations of Dr. C. P. Steinmetz, chief electrician of the General Electric Company. Its chief characteristics are long life of electrodes—approaching 200 hours on a single burning—light of great carrying capacity and good distribution, high intrinsic brilliancy with low energy consumption.

The arc derives its name from the fact that the negative electrode is composed chiefly of magnetic iron ore with a certain percentage of titanium oxide added (TiO_2). The positive electrode is of copper, the size of which has but little effect on the behavior of the arc.

The magnetite arc differs radically from the ordinary carbon arc and also from the flaming arc in that it can be operated only on direct-current circuits. It is also essential that the magnetite electrode should form the negative electrode which is, as a rule placed in the lower holder of the lamp. If magnetite is used for the positive as well as the negative electrode the arc falls off both in brilliancy and efficiency; and the positive electrode, which when metallic lasts 2,000 hours or more, is more rapidly consumed.

The bulk of the electrodes consist of magnetite, the particles of



OUTDOOR LIGHTING BY "ALBA" FLAMING ARC LAMPS.
The upper view is in the streets of Cologne; the lower, in the suburbs of Berlin.
Courtesy of the Charles L. Kiewert Co.

which make the arc stream a good conductor, while the titanium oxide is introduced to give luminescence and to neutralize the excessive blue rays emitted by the iron arc alone. The use of magnetic iron ore and titanium oxide alone in the negative electrode, however, would make the arc too unstable for any commercial use, hence to obviate this defect and at the same time increase the life of the electrodes, either oxide of chromium ($Cr_2 O_3$) or chrome iron ore ($Fe_2 Cr_2 O_4$), termed chromite, is added, the latter, perhaps, being the most suitable. The slag formed by the magnetite is a good conductor when cold, so that difficulties in starting the arc are overcome. Ordinary magnetite contains too many impurities to be used, and contaminating substances, such as lime, silicia and magnesia, must be first eliminated.

The arc of the magnetite lamp appears to arise from the surface of the negative as a high velocity blast impinging on the copper positive, and since the greater portion of the light is emitted at the negative end of the vapor bridge, a reflector must be employed to give the most satisfactory results. It is thus obvious that considerable gain in efficiency is practicable by burning the arc reversed or with the negative in the upper holder of the lamp. Until recently the mechanical difficulties to this arrangement caused it to receive small consideration, although the advantages were everywhere recognized. In the Westinghouse magnetite arc the negative electrode is in the upper instead of the lower portion of the lamp.

The arc of the magnetite lamp is very long and gives a better distribution of light than does the old open-arc carbon lamp, while the energy consumption is only 4 amperes at from 65 to 75 volts. The maximum light is emitted between 20 degrees and the horizontal, while the total light produced by a 300-watt magnetite arc is approximately double that of an alternating-current series enclosed carbon lamp consuming 450 watts.

The principal disadvantages of the magnetite lamp may be briefly stated as follows and are due to the positive, in the main: (1) Continuous service of the lamp causes films to be deposited on the positive electrode, which deposits project downwards like icicles and greatly obstruct or sometimes entirely cut off the light; (2) the substances employed in the positive may oxidize from the intense heat of the arc and from oxides, which, when cold, are insulators; (3) particles of molten matter are absorbed by the positive from the negative and the burning of the arc is thereby hindered.

Experience has shown that unless special means are provided for the ventilation of nearly all types of luminous or flaming arc lamps the solid matter emitted by the arcs in the form of smoke is deposited upon the inclosing globe forming a semi-opaque coating which is greatly detrimental to the light emission.

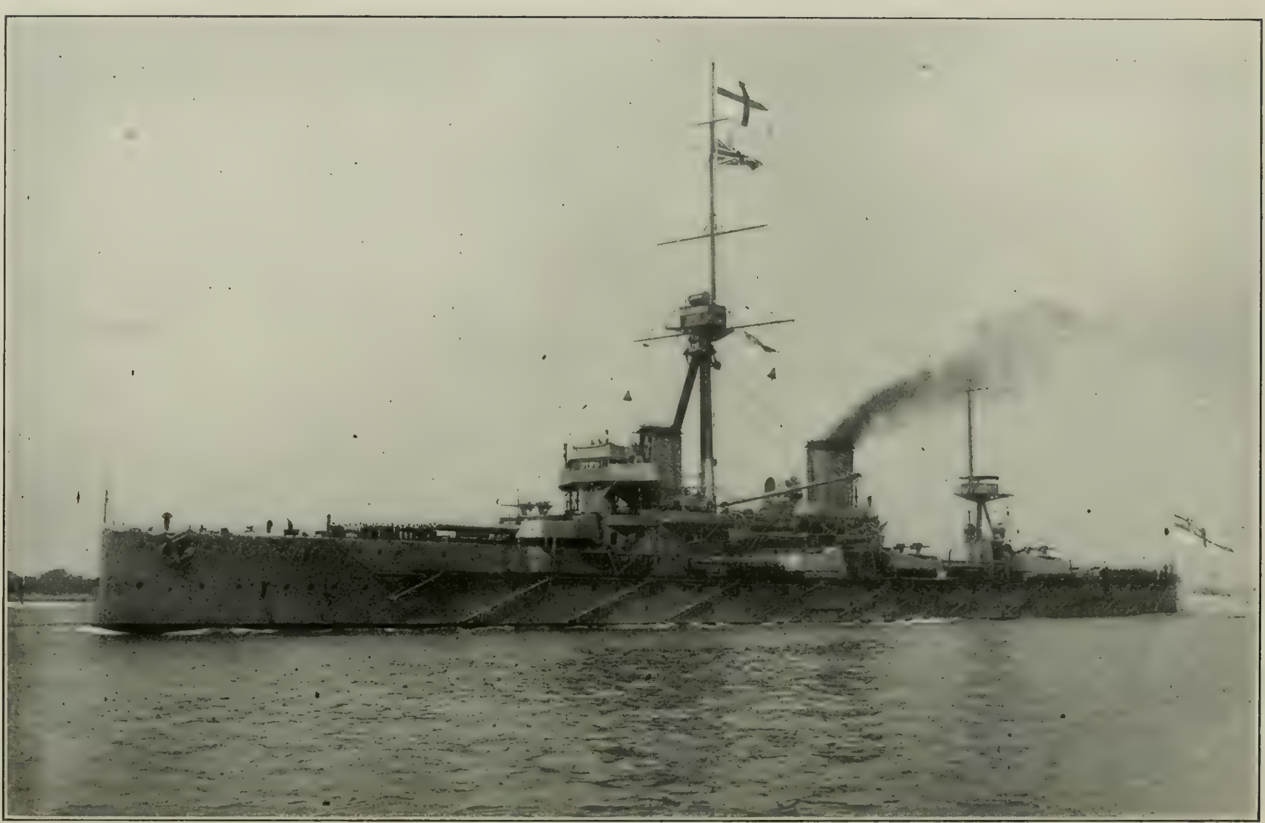
ILLUMINATION AND COLOR.

The spectrum of the magnetite arc with electrodes of correct composition approaches that of sunlight more nearly than that of any other kind of arc lamp, while the distribution of the light rays in a plane about 10 degrees below the horizontal makes the lamp especially suitable for street illumination.

The unusual advantages of the magnetite arc, such as long life of electrodes, high luminous efficiency with low maintenance expense, are resulting in the displacement of the enclosed arc lamp for new installations and there are many indications that the magnetite arc will supplant the older types of arcs for street lighting, entirely.

Magnetite lamps operate most satisfactorily on direct-current circuits, as has been pointed out, the lamps being connected in series and receiving energy either from a constant-current arc dynamo or from an alternating-current circuit, the current being transformed into direct current by means of "mercury rectifiers." The alternating current to be rectified is first sent through a repulsion-coil regulating transformer (or constant-current transformer) and then goes through the rectifier to the lamps. The combined efficiency of the constant current transformer and mercury rectifier is over 90 per cent.

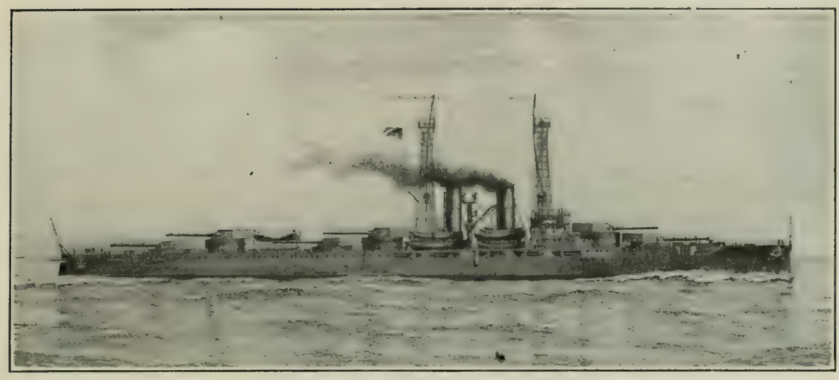
The chief objection to the luminous arcs as made at present is that the attempt to specialize the lamps in the direction of long life has resulted in its failure in other desirable qualities. It is very difficult to obtain authoritative values for these arcs for the reason that until very recently they were designed entirely for low input and have been generally tested with clear globes.



H. M. S. DREADNOUGHT.

Note:—The Dreadnought, Bellerophon and Collingwood classes are much overweight, drawing considerably more water than called for by the design, and displacing between 20,000 and 21,000 tons each. The figures in the tables on page 524 are *nominal,* only.

Photo by Stephen Cribb, Southsea.



THE U. S. BATTLESHIP ARKANSAS.

DREADNOUGHTS—WHAT ARE THEY?

By Sidney Graves Koon, M. M. E.

In view of the importance of the pending naval appropriations and of the increasing public interest in the efficiency of naval defence, this clear and thorough review of the most advanced battleship types and naval programmes is both timely and valuable.—The Editors.

BATTLESHIP-DESTROYERS—the extreme of power, both ballistic (in the guns) and dynamic (in the propelling machinery)—the sudden culmination of years of steady and painstaking development, the last few stages being bridged by a half-dozen "semi-*Dreadnoughts*"—disturbers of the peace of mind of naval administrations, and hence—incentives to greater and ever greater budgets, until the price of peace grows in some quarters almost intolerable. This, and more, *Dreadnoughts* are. They have revolutionized naval design in many ways, increasing by thousands of yards the assumed practicable battle range; stimulating, to meet this condition, the development of the most powerful and wonderfully accurate torpedoes—tiny submarines which, without guidance once they have left the firing tube, can be relied upon to travel miles in a straight line, carrying a deadly charge of guncotton far into the enemy's ranks. New theories of gunnery, involving the use of but one size of gun, and that the largest, have resulted in eliminating all intermediate sized guns, and relegating the smaller pieces to the sole duty of guarding against the attacks of torpedo vessels. This makes for simplicity in fire control, or directing the operation of the battery against the enemy or the target; for all the projectiles will have the same sort of trajectory—all will rise to the same height in their travel over equal distances, and the guns will all be given the same elevation.

New problems, and grave ones, have entered into the design:—the proper disposition of several heavy turrets, so that too great a concentration of weight in one spot is avoided, yet so that no one of them interferes in any way with any of the others, while all have the greatest possible arc of training; the provision of adequate locations for the stowage of boats—for the familiar hammock netting capped by boatskids is a thing of the past; the fitting of armor in such a way as to localize the effects of a hit from a heavy projectile filled with high explosives; the almost total elimination of wood in the construction, and even for furniture, because of the serious effects of a conflagration started by bursting shells; and, in the latest ships, a sort of embryo protection against aeroplanes by means of an armored upper deck. And, be it said, *Dreadnoughts* are *not* put up in small packages.

But, getting away from this generalization, we once more face our topical question—What are *Dreadnoughts?* Briefly, they are large battleships of high speed, carrying from eight to twelve or more very heavy guns, and having hull and guns extensively protected by heavy armor. Compared with the latest ships of the "pre-*Dreadnought*" epoch, such as the United States ship *Connecticut,* in which Evans made his famous cruise, the *Dreadnoughts* are larger by several thousand tons, faster by three knots or more, and have broadsides of from eight to twelve heavy guns as against four on the *Connecticut.* The numerous intermediate guns mounted on ships of the *Connecticut* and contemporaneous types have disappeared. The relative area of the side covered by armor has increased, while the maximum armor thickness has remained about the same.

The most vexing problem in connection with *Dreadnoughts* has been that of arranging a satisfactory distribution of the tremendous batteries carried. Of the three nations which first entered the field and undertook to solve this problem, the United States is the only one which seized at the start an idea which has persisted to the present, and which, greatly to the credit of the American designers, has now been adopted by the British Admiralty—that of mounting all the heavy guns in pairs in turrets, all on the center line. The original *Dreadnought* and her six immediate successors had two of the guns masked by the superstructure, and could train on one broadside only eight of the ten carried. This was avoided in the *Indomitable* by mounting two turrets *en echelon,* or diagonally, thus allowing for both a heavy bow and stern fire, and a complete broadside; but the strain

ABOVE, H. M. S. INDOMITABLE; BELOW, H. M. S. VANGUARD.
See page 524. Photo by Stephen Cribb, Southsea.

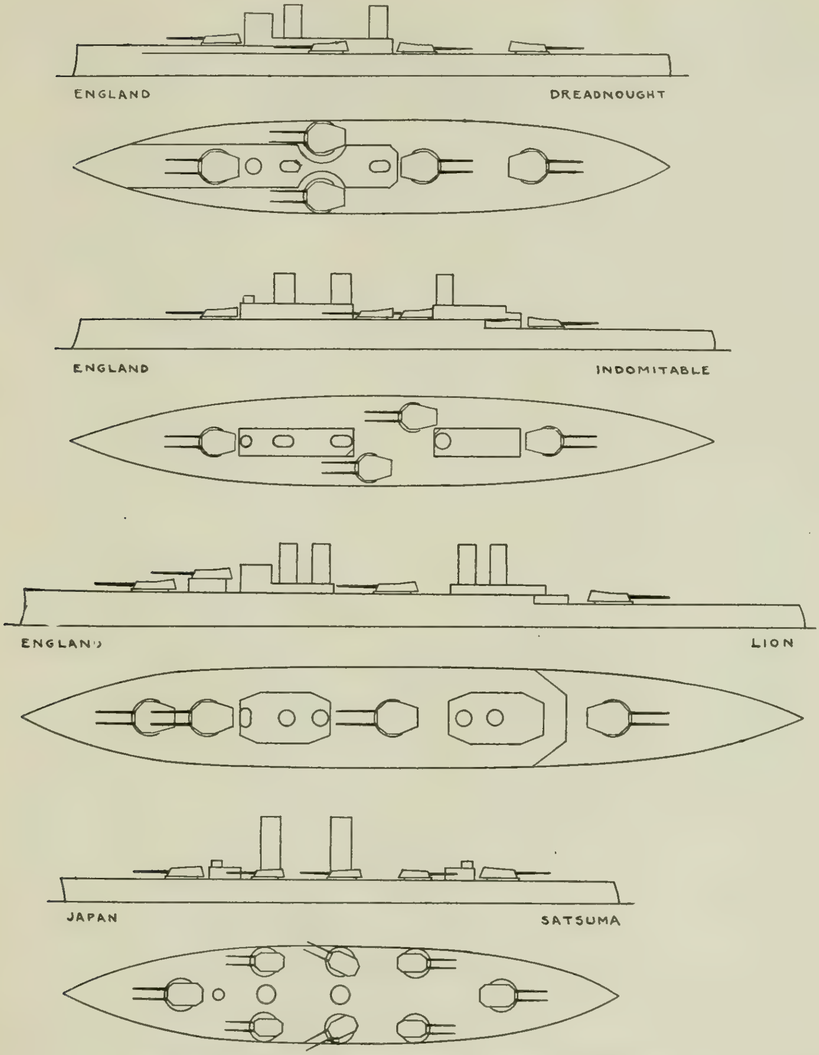
on the decks and the necessarily limited arc of cross-deck firing made the arrangement unsatisfactory. It has been followed, however, in a great many ships. The original German ideal was proclaimed to be "all guns on one broadside," and such was the number of guns which it was proposed to so mount that the greatest alarm pervaded British naval circles, lest the Teuton, by some magic arrangement of so many weapons, might have stolen a march on his cousins. When the ships actually took form, however, only eight guns were found available on either side, of the twelve carried, and everybody breathed more easily. But more of this anon.

THE BRITISH SHIPS.

First chronologically and numerically, these ships should be first described. For purposes of reference, a list follows, showing the names and main particulars of all *Dreadnoughts* built or building for the British navy, and including the two "semi-*Dreadnoughts*" *Agamemnon* and *Lord Nelson*.

	Tons.	Speed.	Battery.			Broad-side. lb.	Armor. in.	Length. ft.
Agamemnon *Lord Nelson*	16,500	18.8	4 12 -in.	10 9.2-in.	15 3-in.	5,388	12	425
Dreadnought	17,900	21.2	10 12 -in.	27 3 -in.		7,000	11	520
Bellerophon *Superb* *Temeraire*	18,000	21.5	10 12 -in.	20 4 -in.		7,203	11	520
St. Vincent *Collingwood* *Vanguard*	19,250	21.	10 12 -in.	20 4 -in.		7,203	11	530
Neptune *Hercules* *Colossus*	20,400	21.	10 12 -in.	20 4 -in.		8,965	11	540
Orion *Thunderer* *Monarch* *Conqueror*	23,500	21	10 13.5-in.	20 4 -in.		12,965	12	550
Indomitable *Invincible* *Inflexible*	17,250	28.	8 12 -in.	16 4 -in.		7,172	7	560
Indefatigable *Three more not yet named*	19,200	26.	8 12 -in.	20 4 -in.		7,234	8	578
Lion *Princess Royal*	26,350	28.	8 13.5-in.	20 4 -in.		10,434	8	680

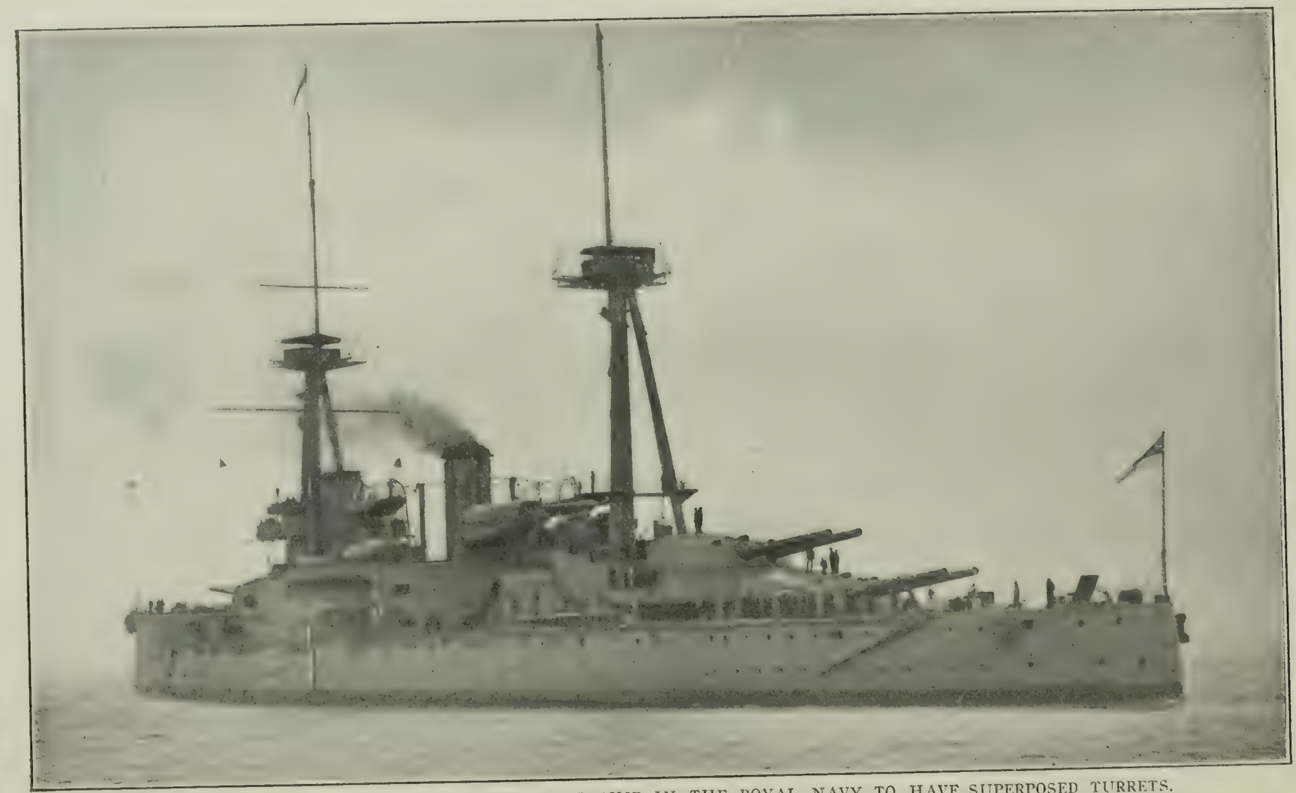
The diagram showing the battery arrangement of the *Dreadnought* is equally available for the *Bellerophon* and *St. Vincent* classes. In each case, there are three turrets on the center line, and one on either wing, a little forward of amidships. This gives a fire of six guns dead ahead or dead astern (but only four, when we get two degrees from the exact axial line) and eight on the broadside. Contemporaneous with these ships were the *Indomitables,* also illustrated, where the *echelon* arrangement of the central turrets, above referred to, gives the same number of guns ahead, astern, and on the direct broadside as with the *Dreadnought.* At a small angle away



THE BRITISH SHIPS. SCALE ABOUT 1 INCH = 165 FEET.

from the direct broadside, however, the "off" pair of guns is out of action, and six weapons are all that can be used. This *Indomitable* arrangement, slightly modified, to give less interference of the guns with one another, has been followed in the *Indefatigable* type of four ships, three of which are being built from moneys subscribed by as many of the crown colonies.

The first evidence of the influence of American design on the British ships is in the *Neptune* class, where the two after center-line



H. M. S. NEPTUNE, 20,000 TONS; THE FIRST SHIP IN THE ROYAL NAVY TO HAVE SUPERPOSED TURRETS. Her beam barbettes, *en echelon*, give her a full broadside of 10-in. guns. Photo by Stephen Cribb, Southsea.

turrets are so mounted that the guns of the inner one may be fired over the after turret. This ship also used the *echelon* arrangement for the central pairs of guns. The illustration of the Argentine *Rivadavia* shows the manner in which these ten guns are mounted, if we remember that in the *Neptune,* one of the two forward turrets of the *Rivadavia* is missing. But it was in the *Orion* class of four ships, of which the vessel named was launched August 20, 1910, that the design came out so like the American *Delaware* (see page 528) as to cause comment. The main difference is that there are three turrets forward and two aft on the *Orion,* while the reverse is the case with the *Delaware.* Another point of difference is that on the *Orion* the middle one of the group of three turrets is the one which is raised above its fellows, while on the American ship the elevated turret is the one nearest the middle of the ship. In each case there can be used four guns ahead, four astern, and ten on either broadside.

The latest of the British ships are the *Lion,* launched August 6, 1910, and her sister *Princess Royal,* still on the stocks. These are shown, by the diagram, to have their eight guns in four turrets on the center line, like the *Michigan,* also illustrated; but, unlike the latter ship, only two guns can be fired aft, though four can be trained ahead, and eight on either side. These two ships are remarkable from the fact that they are the first war vessels to approach 700 feet in length—the first, in fact, to exceed 600 feet! and also that, with their 70,000 horse power, furnished by steam turbines, they are the first to pass 50,000 horse power.* They have about the same power as the Cunard liners *Lusitania* and *Mauretania,* and, with hulls one-third lighter, are expected to exceed the high speed of those famous ships by about three knots. Needless to say, they represent an extremely expensive investment, not only in capital cost, but in maintenance and depreciation.

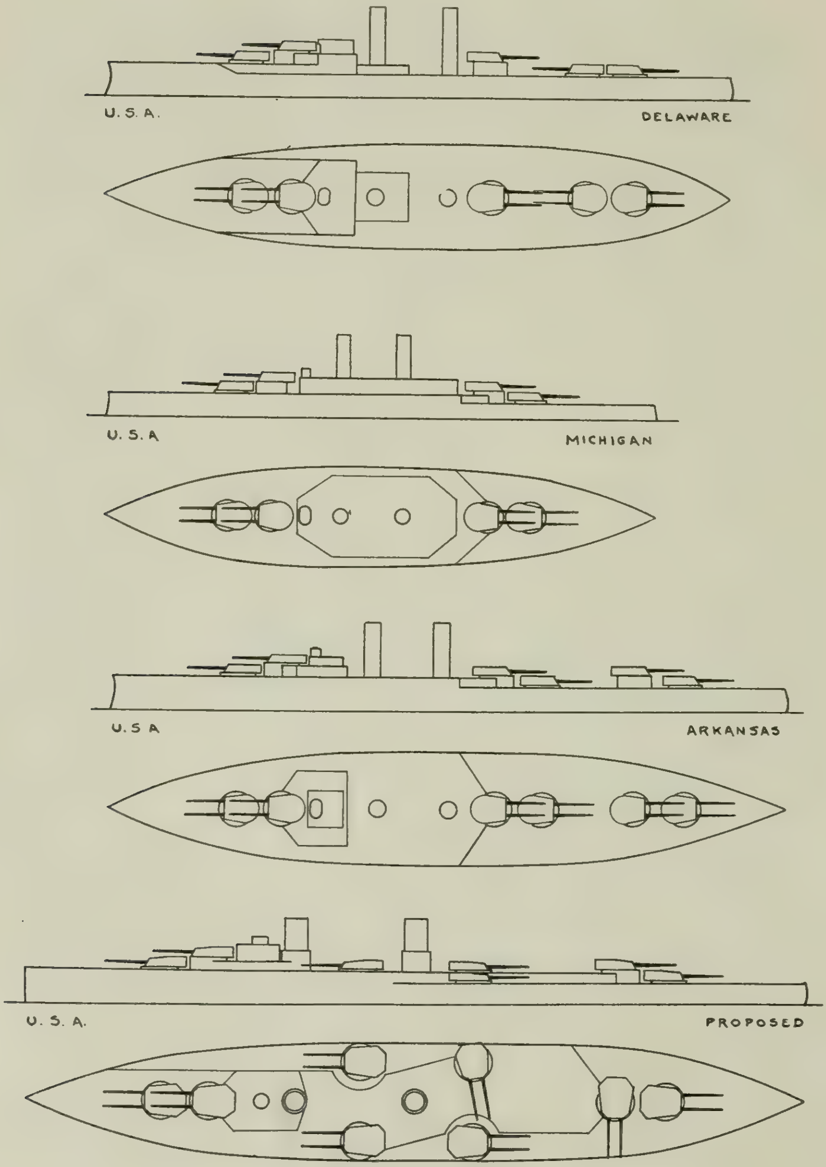
THE AMERICAN SHIPS.

	Tons.	Speed.	Battery.		Broadside. lb.	Armor. in.	Length. ft.
Michigan *South Carolina*	16,000	18.8	8 12-in.	22 3-in.	7,114	11	450
Delaware *North Dakota*	20,000	21.6	10 12-in.	14 5-in.	9,120	11	510
Florida *Utah*	21,825	21.	10 12-in.	16 5-in.	9,180	11	518
Arkansas *Wyoming*	26,000	20.5	12 12-in.	21 5-in.	11,040	11	554
Oklahoma *Nevada*	29,000	21.	10 14-in.	20 5-in.	14,600	11	570

The *Michigan* type immediately followed the *Connecticut* class, of the same displacement. The former is illustrated, showing four tur-

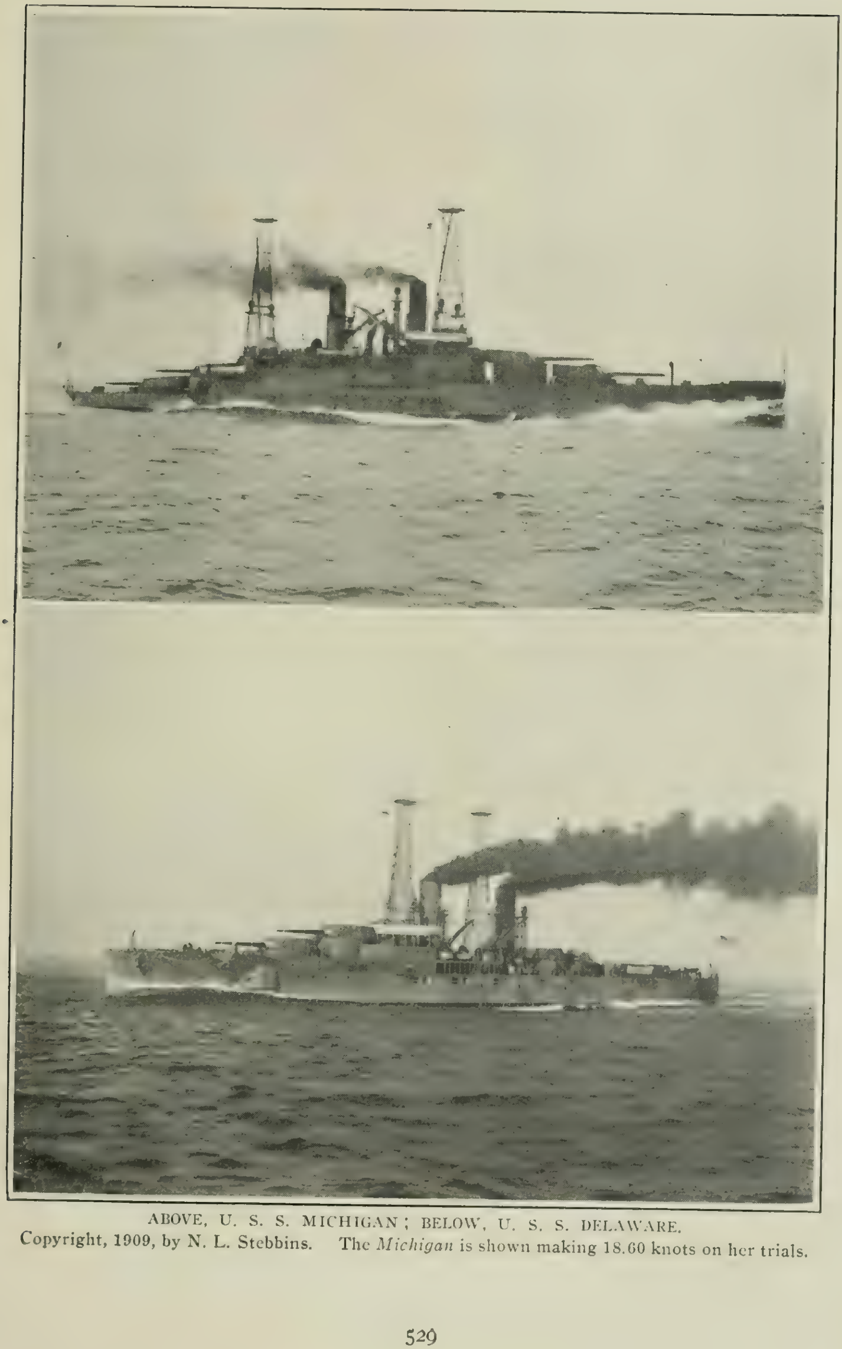
---

* The *Von der Tann,* on trial, has also exceeded this figure.



THE AMERICAN SHIPS. SCALE ABOUT 1 INCH = 160 FEET.

rets on the center line, the inner ones being elevated for training over those at the ends, thus giving a fire of four guns ahead or astern and all eight on the broadside. This appears to be the most successful



ABOVE, U. S. S. MICHIGAN; BELOW, U. S. S. DELAWARE.
Copyright, 1909, by N. L. Stebbins. The *Michigan* is shown making 18.60 knots on her trials.

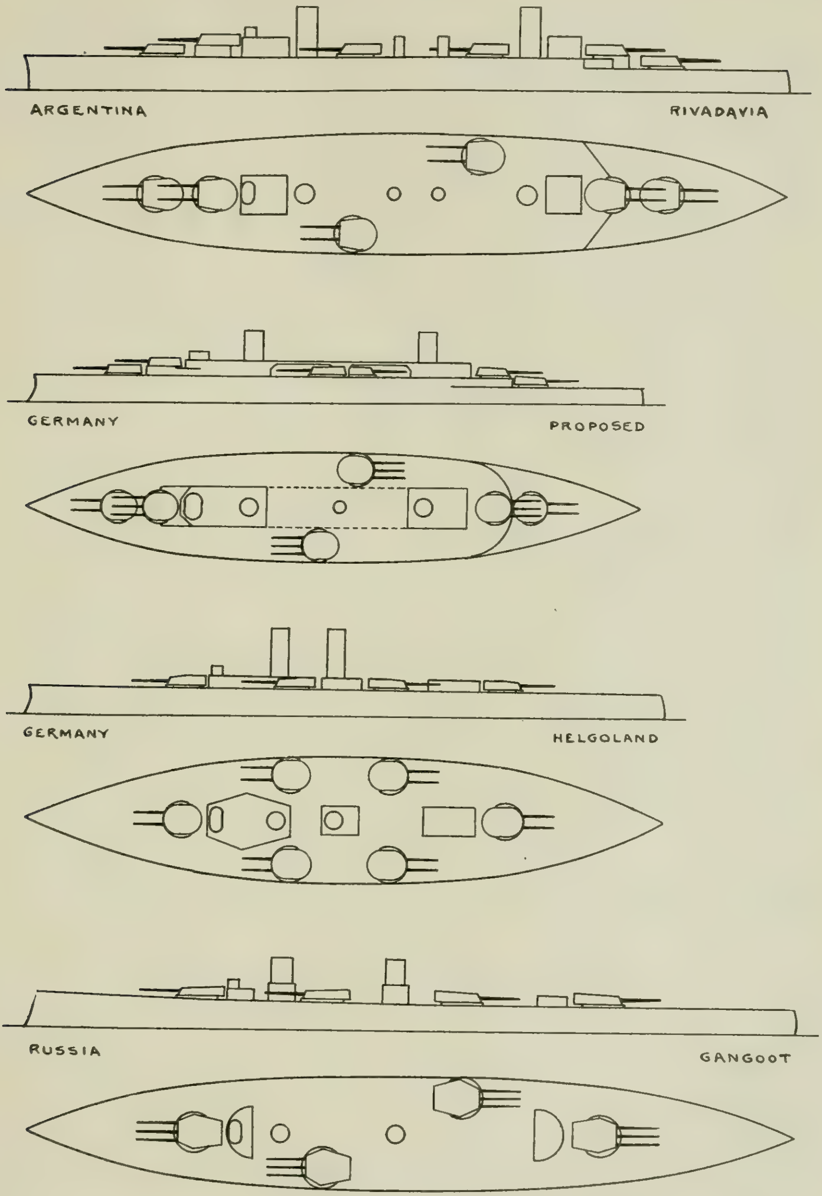
type yet developed, having now been adopted as such by England. It gives the best "all-around" fire possible; and many designers feel that the best general results would be obtained by following this arrangement of four turrets, increasing the caliber of the guns, if need be, or even mounting three guns in a turret, as with the Russian *Gangoot* class (see illustration). The increased power of some of the latest designs along other lines would then be met by a corresponding increase in the number of ships of this type, uniform in general design, and with all the tactical advantages conferred by a homogeneous fleet.

Following the *Michigan* came the *Delaware* and *Florida* classes, the latter being merely a development of the former. Each has ten heavy guns mounted in five turrets on the center line, and all available on either side. A further development, involving the addition of another turret on the center line, has resulted in the *Arkansas* and *Wyoming,* of 26,000 tons displacement, and carrying twelve 12-inch guns, arranged as shown on the diagram. The *Oklahoma* class follows the *Florida,* so far as gun disposition is concerned; but as the guns are increased from 12-inch (870-pound projectile) to 14-inch (1,400-pound projectile) the new ships are necessarily much larger.

THE GERMAN SHIPS.

	Tons.	Speed.		Battery.		Broad-side. lb.	Armor. in.	Length. ft.
Nassau *Posen* *Rheinland* *Westfalen*	18,700	19.8	12 11 -in.	12 5.9-in.	16 3.4-in.	6,888	9.8	472
Helgoland *Ostfriesland* *Thüringen* *Six more not yet named*	21,000	20.5	12 12.2-in.	12 6.7-in.	16 3.4-in.	8,800	9.8	490
Von der Tann	18,700	25.	8 11 -in.	10 5.9-in.	16 3.4-in.	6,780	6	560
Moltke *H* *K*	19,500	28.	8 12.2-in.	12 5.9-in.	16 3.4-in.	8,656	6	560

The German fleet of *Dreadnoughts* is nothing but an "answer" to that of England. As soon as the particulars of the original *Dreadnought* became known, the *Nassau* was designed, and, after many vicissitudes, finally built. But she bears no resemblance, in steel, to her first drawings. As mentioned previously, nothing was to be considered which did not allow all guns to be trained on one broadside. So designs resembling the present actual ship, as well as modifications carrying fourteen guns (the extra turret, on the center line, being elevated so as to fire over one of the end turrets) and sixteen guns arranged as in the Japanese *Satsuma,* were discarded in favor of a hybrid arrangement of sixteen guns in six turrets, as shown in the diagram "proposed." This would have permitted the attainment of the stipulated ideal; but it must have been found totally impracticable



GERMANY, RUSSIA AND ARGENTINA. SCALE ABOUT 1 INCH = 150 FEET.

on account of the limited displacement allotted, and was finally abandoned in favor of a very inferior disposition, illustrated by the diagram of the *Helgoland,* which is merely an enlargement of the *Nas-*

sau, with heavier guns. Had the arrangement of turrets in the sixteen-gun ship "proposed" been retained, but with only two guns to each turret, it would have been identical with that which was later adopted for the two Argentine ships building in the United States, and the Brazilian *Rio de Janeiro,* building in England—a most successful design. In connection with the German answer to the *Indomitable,* a ludicrous case of misapprehension, based on an erroneous statement of the displacement of the English ships, is noted. Instead of 17,250 tons, the figure was given as 15,000 tons; and the Germans gravely went to work to design a ship of that displacement and 25-knots speed. She was actually so far advanced in construction when the hoax was discovered that she was carried to completion. This ship, now the *Bluecher,* was given originally an armament of eight 11-inch guns, to meet the British eight 12-inch pieces. These were to be mounted in pairs in four turrets arranged lozenge-wise—one on the centerline forward, and one aft, and one on either side, amidships. This battery was later increased to ten guns, as being better fitted to cope with the eight larger British weapons. The two extra guns were mounted singly in two turrets, one on each side, the resulting six turrets being arranged as in the present *Nassau.* But this was too much for her light displacement, and the battery, as finally fitted to the ship, consists of twelve 8.2-inch guns, in six turrets arranged as last noted. She is not a *Dreadnought,* in any sense of the term.

The present *Von der Tann,* as originally designed, was to have carried twelve 11-inch guns, disposed as in the present Argentine ships. This, again, proved too heavy, and the ship as completed has only eight, in four turrets, arranged as in the *Indomitable.* The *Moltke,* and later ships of this class, have the same arrangement, but carry heavier guns.

THE FRENCH SHIPS.

	Tons.	Speed.	Battery.			Broad-side. lb.	Armor. in.	Length. ft.
Danton *Condorcet* *Diderot* *Mirabeau* *Vergniaud* *Voltaire*	18,320	19.5	4 12 in.	12 9.4-in.	16 3-in.	6,902	10.8	476
Moliere *Dumas* *Corneille* *Racine* *Jean Bart* *No. 6*	23,467	21.	12 12-in.	22 5.5-in.		10,580	10.8	542

The French and the Japanese evolved powerful designs, almost simultaneously, immediately after the *Dreadnought's* particulars became known, and both achieved the same end—a semi-*Dreadnought* carrying four 12-inch and twelve 9.4-inch (10-inch, in the case of the Japanese) in lieu of the ten 12-inch on the British ship. This arrangement, shown in the diagram of the *Satsuma,* is identical with that of the earlier *Lord Nelson* and *Agamemnon;* this group of three types—British, French and Japanese—embracing ten ships, being the only semi-*Dreadnoughts* ever built, if we except the three Austrian vessels of the *Radetzky* class—smaller and inferior in every way. Many designers expressed a decided preference for this "semi-" design, with its two calibers of heavy guns, but it has now been abandoned on all sides in favor of the single caliber.

The newer French ships are similar in gun disposition to the *Rivadavia,* except that the wing turrets are not placed *en echelon.* In this respect they resemble the *Dreadnought,* for only ten of the twelve guns may be used on one broadside. The end guns, however, as in the *Rivadavia,* are mounted in the *Michigan* style.

THE JAPANESE SHIPS.

	Tons.	Speed.	Battery.			Broadside. lb.	Armor. in.	Length. ft.
Satsuma *Aki*	19,500	20.8	4 12-in.	12 10-in.	10 6 -in.	6,900	9.5	482
Kawachi *Settsu*	20,750	20.5	12 12-in.	10 6-in.	12 4.7-in.	7,570	12	479
Two new ships	22,000	21.	14 12-in.	14 6-in.	10 4.7-in.	9,425	12	500

The *Satsuma* type has already been outlined. The *Kawachi* and *Settsu* carry twelve heavy guns (some reports say fourteen, the two end turrets having three each) in six turrets, arranged as in the *Helgoland.* The original provision for these six turrets appears to have been the same as the present French disposition—an arrangement much superior to that now adopted.

Particulars of the two newer ships are uncertain. Much has been said about a fast design, similar to the *Indomitable,* but more powerful; this, however, does not appear to have gone beyond paper.

The Russian ships (*Gangoot, Petropavlovsk, Poltava* and *Sevastopol*) illustrated by diagram, are unusual in that they carry four three-gun turrets. Their main characteristics appear to be the very complete armor protection, especially on the bottom, as a safeguard against the torpedoes and mines which played such havoc with the Czar's ships in 1904 and 1905; and the arrangement of twelve 12-inch guns in four turrets. The ships are of 23,000 tons and 21 knots, are 590 feet long, and have an armor belt of a maximum thickness of 11 inches. The secondary battery consists of sixteen 4.7-inch guns; and the total broadside is 10,560 pounds. Work on the ships is reported to be proceeding very slowly, because of difficulty in obtaining delivery of guns and armor, and it may be several years before they become available for active service.

The Italian ships, like the Russians, carry twelve 12-inch guns in four turrets; and the disposition of turrets is similar, all guns being available on either broadside. It is reported, however, that instead of each turret carrying three guns abreast, as in the *Gangoot,* there is virtually a double-decked or two-storied turret, carrying two guns below and one above. This would be somewhat similar to the double-decked turrets on the seven American battleships of the *Kearsarge* and *Georgia* classes, in which two heavy guns are carried in the lower or main turret, and two 8-inch guns above. The *Dante Aligheri* was launched September 17, 1910. She is of 19,000 tons and 22 knots. Her length is 500 feet, and her armor belt 9.4 inches in maximum thickness. The secondary battery includes eighteen 4.7-inch and sixteen 3-inch guns. The broadside fire is 10,705 pounds. The other three ships—*Conte di Cavours, Giulio Cesare* and *Leonardo da Vinci* —are to be longer (530 feet) larger (21,000 tons) and faster (23 knots).

The new Austrian ships are reported to be copies of the *Dreadnought.* The first two—*Tegetthoff* and *Kaiser Franz Josef*—have just been begun, but the others will not be laid down until next year. They are of 20,000 tons and 20½ knots, 500 feet long, and with 10 inches of armor. The battery is ten 12-inch and twenty 4.1-inch guns, and the broadside, 7,110 pounds.

The three Spanish ships—*España, Alfonso XIII* and *Jaime I*—are building in Spain from English designs. They are reduced *Indomitables* of medium speed (19½ knots) carrying, on a displacement of 15,700 tons and length of 440 feet, a battery of eight 12-inch and twenty 4-inch guns. The broadside is 7,110 pounds, and the armor belt 8 inches thick.

Interesting as being the first *Dreadnoughts* constructed in the United States for any foreign power, as well as for their sterling qualities, are the Argentine ships *Rivadavia* and *Moreno,* building respectively at the works of the Fore River Shipbuilding Company, Quincy, Mass., and the New York Shipbuilding Company, Camden, N. J. They share with the *Arkansas* and *Wyoming* the distinction of being the only really successful six-turret *Dreadnoughts,* from the point of view of broadside fire, yet put under construction. As shown by the diagram, there are four turrets at the ends, as in the *Michigan,* and two *en echelon* amidships, as in the *Indomitable,* thus giving a broadside of the entire twelve 12-inch guns, as well as enabling six to be fired forward and six aft. The secondary battery includes twelve 6-inch and twelve 4-inch guns, the entire broadside being 10,998 pounds. The displacement is 27,500 tons; the length, 585 feet; and the speed, 22½ knots. The main armor belt is 10 inches thick amidships.

THE BRAZILIAN BATTLESHIP MINAS GERAES AT FULL SPEED.
Built by Sir W. G. Armstrong, Whitworth & Co., Ltd.

The three Brazilian ships are, aside from the Argentines, the only *Dreadnoughts* yet to be constructed outside the country to which they belong, though Chile is about to emulate Brazil in ordering construction in Britain. The first two Brazilians—*Minas Geraes* and *Sao Paulo*—have twelve 12-inch guns arranged much like those on the *Rivadavia,* except that those amidships can be used only on their own side of the ship, the broadside fire being from ten only. The secondary battery contains twenty-two 4.7-inch guns, and the entire broadside is 8,995 pounds. The displacement is 19,250 tons; the length, 530 feet; the speed, 21½ knots; the armor belt, 9 inches thick.

The third ship—*Rio de Janeiro*—is an enlarged copy of the *Rivadavia,* having a displacement of 32,000 tons, a length of 655 feet, and a speed of 22½ knots. Her battery consists of twelve 14-inch, fourteen 6-inch and fourteen 4-inch guns, giving a broadside of 17,717 pounds. The armor belt is 9 inches thick. This is the largest warship ever laid down, as well as the most powerful, being the first to pass 30,000 tons in displacement, and 15,000 pounds in broadside.

As illustrating a possible method of mounting sixteen heavy guns, of which fourteen may be used upon one broadside, the writer last spring submitted to the United States navy department a sketch of a 32,000-ton ship, shown in diagram, which presents some points of interest. The ship was designed for a speed of 21 knots. The main armor belt, 12 inches thick at the waterline, tapers to 9 inches at main deck. The length is 640 feet; breadth, 98 feet; draft of water, 30 feet. The battery, which is the heaviest ever seriously proposed, consists of sixteen 14-inch, twenty-four 5-inch and twelve 3-inch guns, the total broadside being 21,990 pounds. This sketch we may provisionally call the *Alaska*.

SUMMARY OF DREADNOUGHTS AND SEMI-DREADNOUGHTS, BUILT AND BUILDING.

			Batteries				Average		
	Ships.	Tons.	12 in.	9 to 11 in.	3 to 7 in.	Broadside, lb.	Speed.	Tons.	Broadside, lb.
England	25	477,400	220	20	485	211,068	23.15	19,096	8,443
Germany	17	341,000	132	56	474	138,608	21.88	20,059	8,153
France	12	250,722	96	72	228	104,892	20.34	20,894	8,741
United States	10	225,650	100	..	186	102,108	20.9	22,565	10,211
Japan	6	124,500	60	24	112	47,790	20.76	20,750	7,965
Russia	4	92,000	48	..	64	42,240	21.	23,000	10,560
Italy	4	82,000	48	..	136	42,820	22.77	20,500	10,705
Austria	4	80,000	40	..	80	28,440	20.5	20,000	7,110
Spain	3	47,100	24	..	60	21,330	19.5	15,700	7,110
Brazil	3	70,500	36	..	72	35,707	21.95	23,500	11,902
Argentina	2	55,000	24	..	48	21,996	22.5	27,500	10,998
Chile (to build)	2	48,000	24	..	48	21,972	21.	24,000	10,986
Totals	92	1,893,872	852	172	1993	818,971	21.68	20,585	8,902

Large size, in a battleship, is sometimes considered a case of "putting too many eggs into one basket." But it has much to recommend it, from the purely engineering standpoint—entirely aside from the *pride of possession* of a unit of the greatest size and power. Nature has made large activities more efficient—more economical in outlay, relatively speaking—than small ones. And one of the readiest proofs of this economic law is in connection with ships. Suppose, for the sake of example, we compare the 16,000-ton *Connecticut* with the 26,000-ton *Arkansas,* under the assumption that the former is required to attain the speed (20½ knots) of the latter.

To reach this speed under equal conditions of propulsion, the *Connecticut* would require engines and boilers capable of producing 23,900 horse power, which, on the basis of the weight (1,633 tons) of her present 16,500 horse-power machinery, would call for 2,370 tons, or 14.8 per cent of her own weight. But the *Arkansas* has machinery capable of producing this speed, and weighing 2,500 tons, or only 9.6 per cent of her weight. This saving of 5.2 per cent on the weight of the larger ship accounts for no less than 1,350 tons. If, however, the 23,900 horse-power engines of the revised *Connecticut* be turbines, as

A FULL BROADSIDE FROM THE BRAZILIAN BATTLESHIP SAO PAULO.
Built by Sir W. G. Armstrong, Whitworth & Co., Ltd. She is firing ten 12-in. and eleven 4.7-in. guns.

in the *Arkansas,* the weight would be only 1,810 tons, or 11.3 per cent; and the saving in the larger ship would be reduced to 1.7 per cent, or 440 tons.

The armor of the *Connecticut* weighs 3,992 tons. To cover an equal proportion of the area of the larger ship with armor of the same schedule of thickness, the weight would be increased in the ratio of the surfaces exposed, and would amount to 5,520 tons. This is 21.2 per cent of the 26,000 tons, as compared with 25 per cent of the 16,000 tons in the *Connecticut.* This saving of 3.8 per cent in the *Arkansas* represents 990 tons. Similarly, the fuel supply for equal steaming radius, and the equipment and stores, may be shown to represent potential savings of 210 and 180 tons, respectively. The aggregate saving on these four items, on the basis of turbine machinery, is seen to be 1,820 tons, which figure is increased to 2,730 tons, if the reciprocating type of machinery of the *Connecticut* be retained.

Now, as to what could be done with this available weight on the *Arkansas*—

	Tons
Four 12-inch guns, with mounts and ammunition	500
Armor protection for same	350
Extra fuel supply	500
Extra hull armor	470
Total	1,820
Four 12-inch guns, mounts, ammunition and armor	850
Extra ammunition	60
Total	2,730

This is a purely imaginary computation concerning the relative weights which the *mere size* of the larger ship saves, as compared with what the requirements of the smaller one demand. It is simply illustrative of the value of size, as an asset of the naval designer; and serves to explain, in some measure, the reasons operating towards a steady increase in size of ships—a sort of progression which is already taxing our harbor and docking capacities almost to the limit.

Another sort of comparison might be instituted between ships of the *Connecticut* class—the latest pre-*Dreadnought* type in the United States—ships of the *Delaware* class—the first of the American high-speed *Dreadnoughts.* To obtain tonnage equality, let the comparison be between five *Connecticuts* of 16,000 tons (80,000 tons, total) and four *Delawares* of 20,000 tons (also 80,000 tons, total). In the first place, the superior speed of the latter (21½ knots, as against 18½) would enable them to maintain whatever distance (battle range) might be considered most suitable; and this would doubtless be one at which the 8-inch and 7-inch weapons, with which the sides of the *Connecticut* fairly bristle, would be unable to inflict serious damage. In this case the available broadsides would be twenty 12-inch guns from the *Connecticuts,* and forty 12-inch guns from the *Delawares.* The armor protection being also somewhat in favor of the latter, the result of an engagement could not long remain in doubt.

If, however, a closer range were forced by circumstances upon the *Delawares,* their broadsides would be augmented by twenty-eight 5-inch guns, giving them a grand total of 36,840 pounds of metal; while the fire of the *Connecticuts* would be increased by twenty 8-inch and thirty 7-inch guns, giving here a grand total of 27,550 pounds of metal. But, even in this case, there could be little doubt as to the outcome, for the smaller guns could not penetrate the heavy armor protecting the vital portions of the ships of either fleet; and the main brunt of the argument would still be maintained by the 12-inch weapons, with 34,800 pounds opposed to 17,400 pounds. In addition, the concentration of the guns of the four *Delawares* would be much greater than in the case of the five *Connecticuts;* for, assuming a spacing of 400 yards of clear water between ships, the five smaller vessels would cover a total of 2,350 yards, as compared with 1,880 yards for the four larger ships. So, from the point of view of effective gunfire, the *Dreadnought* idea appears completely vindicated.

The subjoined table gives particulars regarding the broadside fire of eighteen representative types already described, showing also the broadside in pounds per thousand tons of displacement, the proportion which the broadside bears to the total possible fire, and the mean arc of the circumference through which the main battery guns may be trained.

Type.	Displacement, tons.	Broadside, lbs.	Broadside, per 1000 tons.	Broadside, per cent of total fire.	Mean arc of fire, degrees.
*Dreadnought**	17,900	7,000	391	79	216
Neptune	20,400	8,965	439	98	258
Orion (A)	23,500	12,965	552	98¾	261
Lion	26,350	10,434	396	98	260
Michigan (A)	16,000	7,114	445	98	280
Delaware (A)	20,000	9,120	456	95½	280
Arkansas (A)	26,000	11,040	425	94½	285
Oklahoma (A)	29,000	14,600	504	96	280
Alaska (*A)	32,000	21,990	687	85	245
*Nassau**	18,700	6,888	368	64	190
*Helgoland**	21,000	8,800	419	64	190
Moltke	19,500	8,656	444	91½	260
*Danton**	18,320	6,902	375	69½	b
*Moliére**	23,467	10,580	451	77	240
Gangoot	23,000	10,560	459	96½	260
Rivadavia (A)	27,500	10,998	400	93	283
*Minas Geraes**	19,250	8,995	467	80½	240
Rio de Janeiro (A)	32,000	17,717	554	95	283

* Part of battery masked. A American in conception. b—Mixed battery.

An inspection of the table will show how the broadside percentage to the total fire falls off as soon as part of the main battery is mounted behind a superstructure—as in ships designated by an asterisk. It also shows how much more powerful are the American secondary batteries than those of most of the other nations(See 94½ and 95½ per cent for the *Arkansas* and *Delaware,* as compared with 98 and 98¾ per cent for the *Neptune* and *Orion*) all main battery guns in each case training on one broadside.

If we average the eight cases where the battery arrangement is of American conception, it is found that they show 512 pounds to each 1,000 tons of displacement, as against 422 pounds for the average of the other ten designs. None of the purely European designs shows more than 260 degrees for the main arc of training; only one American design is below that figure.

Among the special problems which have been produced by the advent of the *Dreadnought* is that of providing for adequate safeguards to prevent the fire of one turret from damaging another. A system of danger signals, giving loud and characteristic warning in turrets when the training of the guns is such as to endanger those of a neighboring turret, has been fitted to many ships, of which the original *Dreadnought* was, quite naturally, the first. Methods of measuring accurately the distance of a hostile ship or a target have necessarily to be carried to much greater nicety.

Special masts have been evolved for carrying these position and range finders and fire-control stations—masts which run practically no risk of being placed *hors de combat* by a single lucky shot. In Britain, this mast takes the form of a tripod of heavy steel tubes. The American skeleton masts are composed of small steel tubes woven into basket form.

But one of the most striking changes is in the simplification of calibers. Ten years ago it was quite customary to fit ships with a perfect museum of guns, so far as different calibers went. Now, all this is changed. Thus, the Russian battleship *Jevstafi* (1903) is listed as carrying four 12-inch, four 8-inch, twelve 6-inch, fourteen 12-pounder, six 3-pounder, six 1-pounder and two 2½-inch (boat) guns, or a total of seven different calibers. The Italian *Regina Margherita* (1901) has almost identically the same battery, also of seven calibers. On the other hand, the *Dreadnought* has ten 12-inch and twenty-seven 12-pounder guns, only two calibers.

In conclusion, some of the limiting conditions affecting increases in size may be pointed out. Draft of water is already a serious problem, for the harbors on the Atlantic and Gulf coasts of the United States are nearly all very shallow, few of them affording sufficient depth for present-day large ships. The Dutch and German coasts on the North Sea are equally hampered, as are various harbors in other parts of the world. Width is limited by entrance to docks, and, now, by the locks of the Panama canal. A clear width of 110 feet is here provided for, which would allow the beam to reach about 105 feet; but the latest vessels have already reached 98 feet. The Panama locks are 1,040 feet long, from center to center of gate pintles, which would here limit lengths to 1,000 feet. This has not been approached, nor is it likely that anything in the near future will do so. The 680 feet of the *Lion* and 655 feet of the *Rio de Janeiro* appear to mark what will probably be the extreme in length for some time to come. Not that progress in dimensions is at all likely to be stopped; but these two cases represent extraordinary steps, and the intervening gap between them and current practice bids fair to be bridged by the usual gradual development.

MODERN MACHINE SHOPS AND INDUSTRIAL PLANTS.

By Charles Day.

AN ANALYSIS OF SPECIFIC EXAMPLES.

Mr. Day's series of articles on the arrangement and construction of industrial plants, referred to in his opening sentence, began in the issue of The Engineering Magazine for September, 1909, with a discussion of the preliminary work, detail plans and specifications, construction, and entry into occupation and operation. This extended through four numbers of the Magazine. The study was resumed in June and July, 1910, by two papers on "Metal-Working Plants and Their Machine-Tool Equipment," followed in September by one on "Routing as a Basis for Laying Out Industrial Plants." In the present issue he summarizes and illustrates the scientific method of attacking industrial construction problems, by a descriptive analysis of various typical establishments. This section of the treatment will be completed next month, and the entire discussion, revised and enlarged, will then be put forth in book form under the title, "Industrial Plants; Their Arrangement and Construction." It is the first thorough and authoritative treatise on the science of works construction to be offered to a professional and industrial audience.—The Editors.

THE preceding series of articles in this series dealt with the "method of procedure" that should be followed when planning and designing industrial plants. Attention was directed especially to the physical requirements which are common to the efficient operation of all plants (irrespective of their output) and it was shown that these requirements can be properly solved for all cases only by those who have a thorough knowledge of the fundamental principles that pertain to every industrial activity. This treatment of the subject was so broad as to preclude the opportunity of direct reference to the characteristics of individual plants. Subsequent articles considered the more special necessities of that group of industries in which the working of metals predominates, and in this instance different types of buildings were illustrated, but described only insofar as they were characteristic of types or representative of certain general classifications, determined by output, without reference to their individual peculiarities.

I have not touched upon the innumerable methods, processes, and procedures that are special for given industries, except as covered by my articles relating to the metal trades and a brief allusion to the hat industry. It is obvious, however, that it is imperative when planning a workshop to have not only a thorough knowledge of the

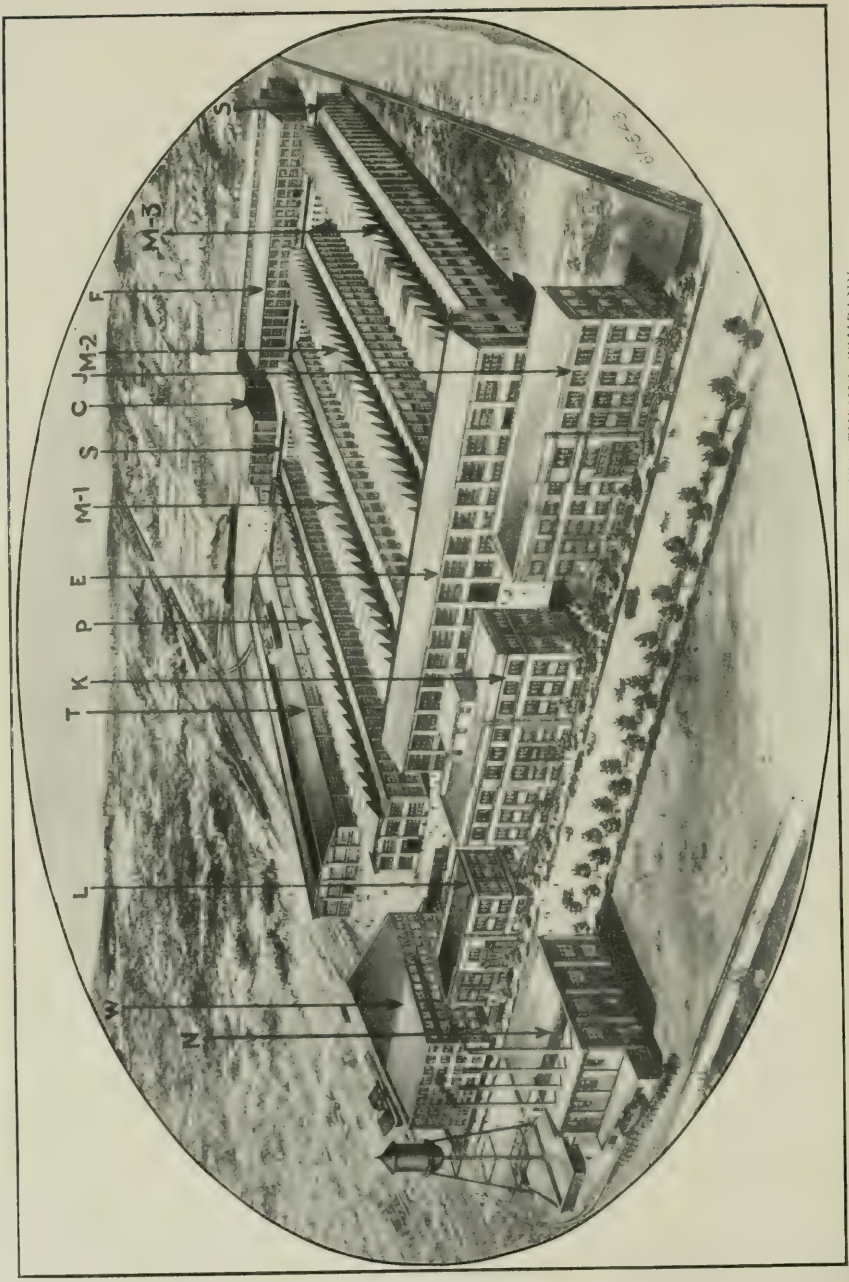


FIG. 1. PLANT OF THE WAGNER ELECTRIC MANUFACTURING COMPANY.

detail processes that will be performed, but also a vast amount of data relating to the proposed business policy of the management. This phase of the entire subject comprises the whole range of industrial handicraft and business policy.

The only way that an adequate idea can be imparted of the interrelationships and far-reaching influences of all the factors involved, would be to describe in full detail the course of reasoning followed when working up some one complex layout; but space is inadequate to give a complete exposition of the aims, purposes, and methods of even a single business, to say nothing of the uses made of such knowledge as a primary basis for the planning and designing work. However, it would seem fitting, as a closing article to this series, to discuss briefly a number of modern industrial plants which have been laid out substantially in accordance with the methods advocated. Even if the whole story cannot be told, attention can at least be directed to the more interesting features that they possess, and in this way I hope to emphasize the real significance of certain of the matters contained in the earlier publications. With this explanation (which I hope will prepare the reader merely for the presentation of the various points of considerable interest presented by the plants herein illustrated, rather than a logical recital of the manner in which the results were brought about), we will proceed with the first example, which is the large plant of the Wagner Electric Manufacturing Company, St. Louis, Mo., builders and manufacturers of a wide variety of electrical apparatus.

Figure 1 shows in perspective the exterior appearance of the ultimate development of the plant that was finally agreed upon by all parties engaged upon this work. At the time this perspective was made the property was held under option only, there being no structures located upon it. We need not dwell upon the necessity of selecting a new site, as the accommodations occupied previous to the construction of the new plant were wholly inadequate for the volume that the business had already attained, leaving out of consideration a very material increase which trade conditions made immediately imperative. Further, the location in question was only one of a number that were taken under consideration, so that in this particular (and I might say in almost every other respect) there were no limitations imposed that interfered with a correct procedure in connection with the preliminary service. The perspective drawing, Figure 1, is of the ultimate development, and so illustrates a plant considerably larger than the one provided by the company at the time the first construction work was carried out. In this regard "factors" representing the increase in capacity desired immediately, as well as those representing the probable increases that would be required from time to time up to the estimated ultimate development, were carefully figured in advance, and adhered to throughout the work.

The more important divisions of the product are alternating- and direct-current motors and generators, covering practically the entire range of capacity for which there is demand, transformers of all sizes, auxiliary electrical apparatus such as starting devices and switchboards, and alternating-current electrical measuring instruments. A condition of the work was that the growth of the business would entail merely a greater output in connection with each of the lines just referred to, rather than the probable addition of other lines of manufacture. Therefore, it was necessary to provide for only such departments as already existed, at the same time making provision for the necessary expansion in these departments to meet future requirements. The brief description that follows gives a general idea of the plan of manufacture.

A very considerable amount of cast iron enters into the product, and for this reason a foundry is provided on the layout that will be adequate for the complete development. The raw material for this foundry is delivered on the siding that passes to the rear of the property as observed from the point of view assumed by the perspective drawing. After the castings are made in foundry "F" they are transported directly across an open way to building "S," which is the raw-material store house, extending across the rear ends and communicating with all the manufacturing and assembling buildings. All castings, therefore, must go through the store house before getting into the shops, so they are properly checked up and recorded on the balance of stores record and, if not needed immediately, they remain in this department. All other raw materials are received on the siding that is shown entering the property at the upper left-hand corner of Figure 1, and as it passes directly alongside of the stores building "S," the various incoming materials can be unloaded and carried to their respective bins, racks, or compartments, with the entailment of a minimum expense. This stores building is a two-story structure, the first floor being on the same level as the floors of the main shops, and the second floor on the same level and communicating with the galleries of the main shops, which are shown in the interior view of building "M-1" (Figure 2).

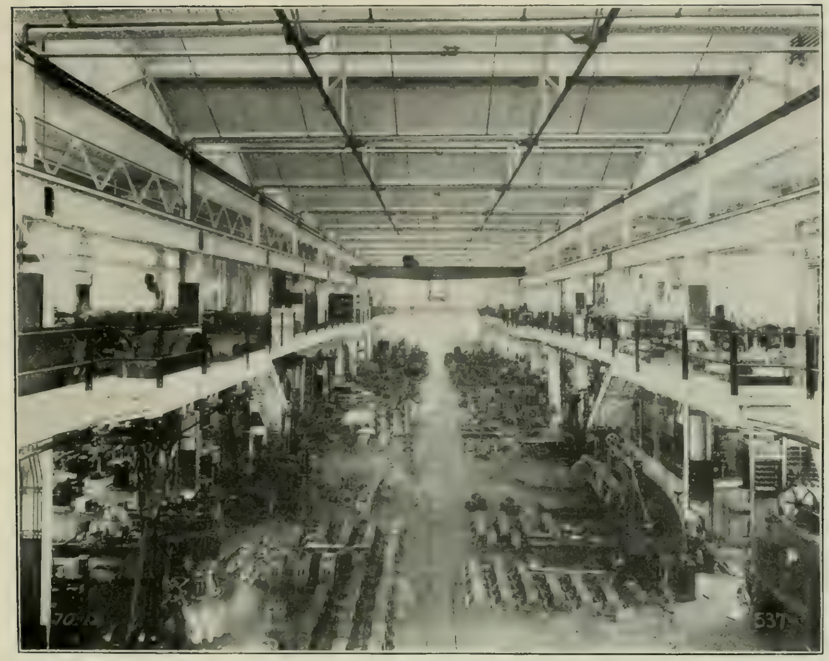


FIG. 2. INTERIOR VIEW OF ONE OF THE MAIN SHOPS OF THE WAGNER ELECTRIC MANUFACTURING COMPANY.

In each case the raw product is stored as conveniently as is possible with regard to the building to which it must ultimately be delivered for the performance of the first manufacturing operations.

As the manufacture of sheet-metal laminations is a function that is common to alternating-current motors, generators, and transformers, building "P," known as the "punch department," was provided for this purpose. Directly adjoining this department and extending into the area way between buildings "P" and "M-I" is located the annealing department, the floor level of which is 11 feet 6 inches below the first-floor grade of the main shops. The purpose of this arrangement will be better understood by referring to Figure 3, which is an interior view of a tunnel, extending directly across the plant, perpendicular to buildings "T," "P," "M-I," etc., and located about midway between buildings "S" and "E."

After the laminations have been pressed out they are lowered on an elevator to the annealing department which is on the same level as the tunnel floor. If the annealed laminations are intended for the transformer shop, building "T," they are wheeled through the tunnel to the elevator communicating with this building, and in the same manner access is given to buildings "M-1," "M-2" and "M-3" without the necessity of going out of doors or in any way interfering with other work which would be the case if loaded trucks were being pushed constantly through the various shops.

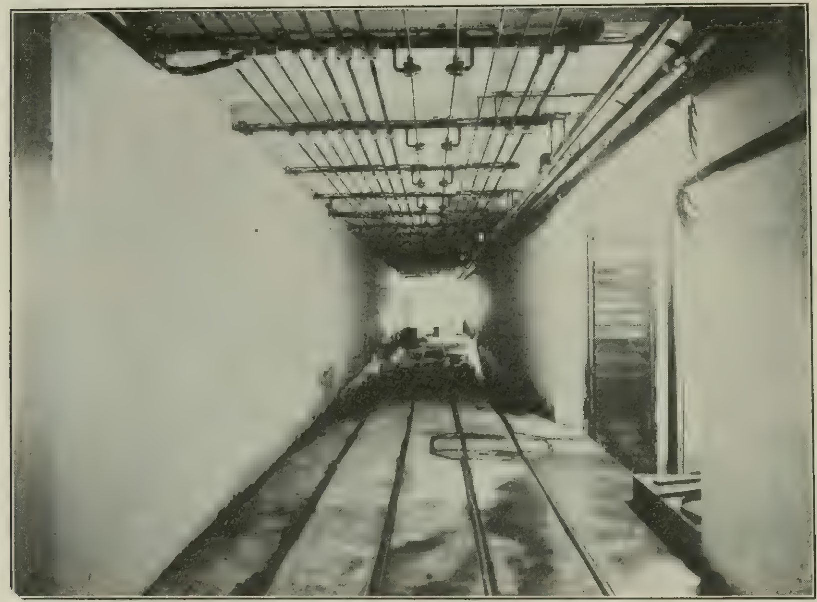


FIG. 3. TUNNEL TRAVERSING PROPERTY OF WAGNER ELECTRIC MANUFACTURING COMPANY.

Motors and generators of various sizes are now made in building "M-1"; the gallery floors and certain sections of the main floor being used for manufacturing work, the machining of large parts, winding, etc., and the balance of the floor space for erection and testing purposes. Building "M-2" will be used for essentially the same class of work, and building "E" for the erection of the largest types of machines that are built. Building "M-3" was provided in the layout to take care of the work on parts and group assembling for the largest product that the company is likely to turn out, and owing to the uncertainty of its character no attempt was made to apportion its space or to determine finally upon the characteristics of the building. Building "J" was provided for the manufacture of electrical instruments; building "K" is the main office; building "L" the service building for employees, and "W" a warehouse for finished product.

The work performed in this plant can be divided roughly between the first two of the three broad classes of metal working discussed in a previous article. The instrument work should be classified under the first division as it is strictly a manufacturing proposition. The building of large motors and generators comes under the second division, as it comprises a definite line of comparatively heavy machinery. Cross sections of buildings "T" and "M-1" were included in the article in question as illustrating the special character of buildings designed for heavy work. It is only necessary to glance at Figure 2, which is an interior view of building "M-1," to see that the character and dimensions of this shop have been governed in practically every detail by the requirements of the work to be performed in it, and that in many particulars the structure of the building forms the function of equipment. This is true not only in connection with the crane runways, the supports for overhead monorails, and the provisions for elevators, but also in connection with certain features of the equipment proper.

The layout that we are considering is characterized by a series of shops arranged parallel to one another, and connected at one end by a raw-materials storage building, and at the other end by an erection shop, except in the cases of the transformer department, from which finished transformers are shipped direct, and the punch department, which serves the machine shops but not the erection department. Flexibility is secured through the possibility of erecting additional shops paralleling those first erected and at the same time extending the stores and erection departments, so making the additional units an integral part of the plant as a whole until such time as the full development, as illustrated by Figure 1, is attained. This general scheme is by no means new, having been resorted to frequently before the Wagner plant was built, one of the best known illustrations being the plant of the Allis-Chalmers Company at Milwaukee.

Provision was made to segregate all the foundry workers from the employees of the other departments, a condition which is in many cases desirable in order to gain an adequate control of the labor situation. The employees of all departments other than the foundry enter the plant through the service building "L," where they dress for their work before going to their respective departments. The time of commencing work, however, is in each case recorded in the departments where they are employed, a condition which is of considerable importance in all large plants. Separate service facilities and entrance and exit to the property are provided for the foundry operatives.

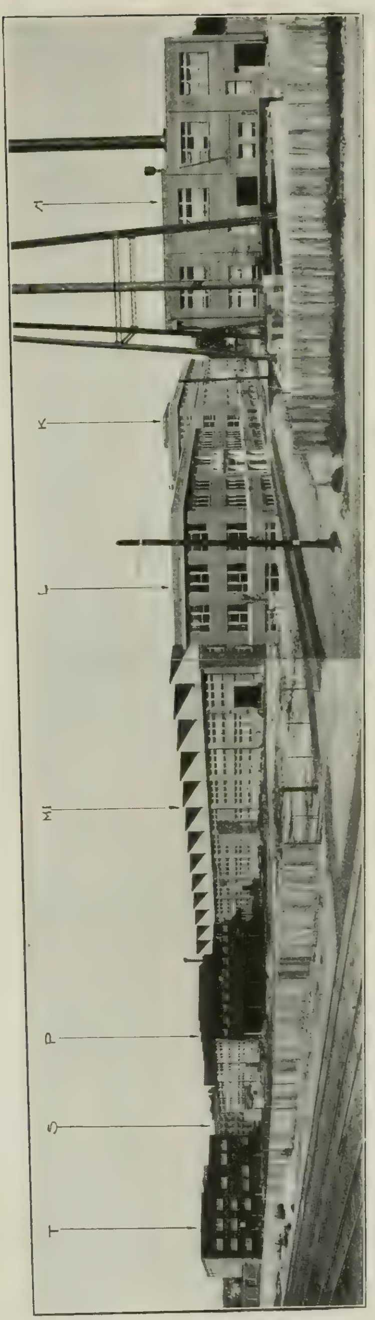


FIG. 4. FIRST CONSTRUCTION WORK IN CONNECTION WITH NEW PLANT OF WAGNER ELECTRIC MANUFACTURING COMPANY.

Figure 4, which is a photograph of the plant immediately after the completion of the first stage of construction, shows clearly the manner in which the necessities of the company as existing at that time were provided for. Buildings "Y," "P," "S," and "N" were erected in part only but buildings "M-1," "K" and "L" were built as shown on the ultimate development. The temporary ends of buildings "T" and "P" appear in the foreground. Construction of the instrument building "J" was deferred, this work being efficiently provided for upon the second floor of building "P." It was purely special conditions, arising principally through the difficulty of acquiring certain property, which resulted in the location of the power plant, building "N," upon a separate plot, but when the necessity for doing this arose, it was found that no serious objections were presented from the standpoint of power generation and distribution, whereas it appeared that the future would probably develop the need of the property adjoining the power plant for the construction of a multiple-story factory.

A very important consideration that always confronts the industrial engineer is the character of buildings that should be adopted for different purposes. There are usually certain limits of expenditure that are possible, the lowest of which must at least allow of the reasonably efficient performance of the industrial work, whatever it may be, whereas the upper limit represents an expenditure that meets not only the shop requirements proper but those incident to the provision of buildings of a thoroughly permanent character and attractive appearance, incorporating also all the refinements in furnishings and appliances that form a consistent part of such structures. The very nature of some businesses is such that they should not be handicapped by the interest charges that would follow the adoption of recommendations based upon what I have termed the upper limit of expenditures; and in other cases, aside from the utility that the greater disbursement may represent, it is impracticable to secure the necessary funds.

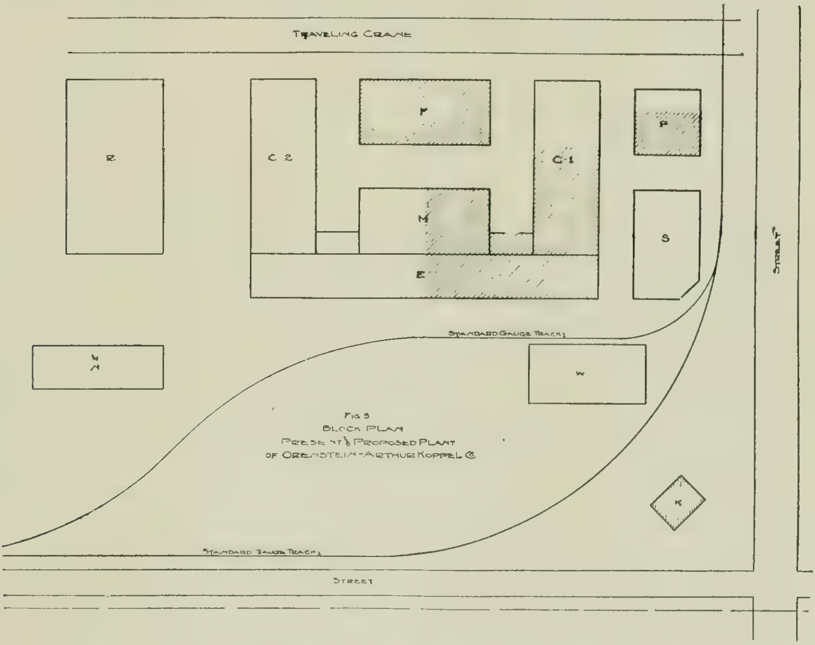


FIG. 5. PLAN OF PROPERTY, ORENSTEIN-ARTHUR KOPPEL COMPANY.

The new plant of the Orenstein-Arthur Koppel Company, built a few years ago at Koppel, Pennsylvania, and recently enlarged in capacity, is a good illustration of an instance where every dollar that was spent went for some positive utility. The plan of ultimate development of their property is illustrated by Figure 5, and Figures 6 and 7 are photographs showing the plant as a whole, prior to its enlargement, and the interior of the erection shop, respectively.

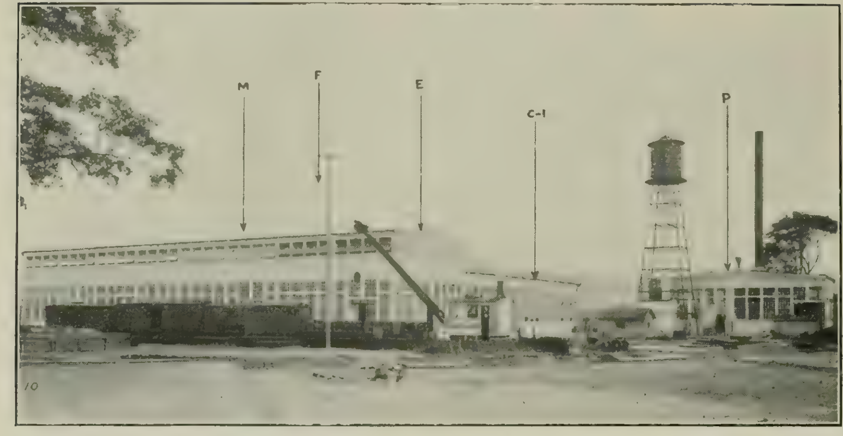


FIGURE 6. PLANT OF ORENSTEIN-ARTHUR KOPPEL COMPANY, KOPPEL, PENNSYLVANIA.

This company manufactures high-grade contractors' equipment, including principally dump cars of all kinds and industrial-track systems. The labor cost per pound upon this product is very low, so it is absolutely imperative that the cost should be burdened with a minimum overhead expense; for in any case it will be a considerable part of the total cost, and unless this condition of minimization were complied with the company would occupy a vulnerable position. It was on this account that practically everything was made subservient to utility insofar as this course was reasonable when designing and building the plant of Orenstein-Arthur Koppel Company.

Buildings "C-1," "C-2," "F," "M" and "E" form a complete group for the manufacture of the entire range in capacities of industrial cars of many different types. The raw materials, which comprise principally sheet steel and structural shapes, are received on the siding passing between building "P" and the property line and are unloaded by means of a gantry crane and carried by this crane to the proper section of the storage yard. Building "C-1" is known as the light car shop and building "C-2" as the heavy car shop; the structural and sheet-metal work as well as certain preliminary assembling operations being performed in these departments upon the respective divisions of the product. These shops are served by cranes that operate lengthwise of the buildings and on either side of the central row of columns.

Building "F" is the forge shop, which serves about equally the light and heavy car work, and building "M" is the machine shop which serves buildings "C-1," "C-2," and "E," the latter being the erection shop, an interior view of which is shown in Figure 7. It will be seen that the arrangement of departments reduces the handling of material to a minimum, a condition which also makes for the most ready supervision of the work. There is no dividing wall between building "M" and "E," and by locating the tool room in building "M" directly adjoining the erection department, as shown in Figure 7, it is made most accessible to all the departments it serves. Building "R" was provided for the frog and switch work, building "S" for the storage of miscellaneous raw materials, and an office building "K" was provided which does not show in the photographs.

The first construction work that was carried out by this company included the erection of the buildings which are cross-hatched on Figure 5. However, the plant has been extended since that time. All the equipment is motor-driven through the medium of either the direct or group method. The power plant, building "P," contains direct-connected generators delivering to the various departments direct current at 220 volts, a three-wire system being used for the lighting. Wherever the requirements made it desirable, adjustable speed motors were installed.

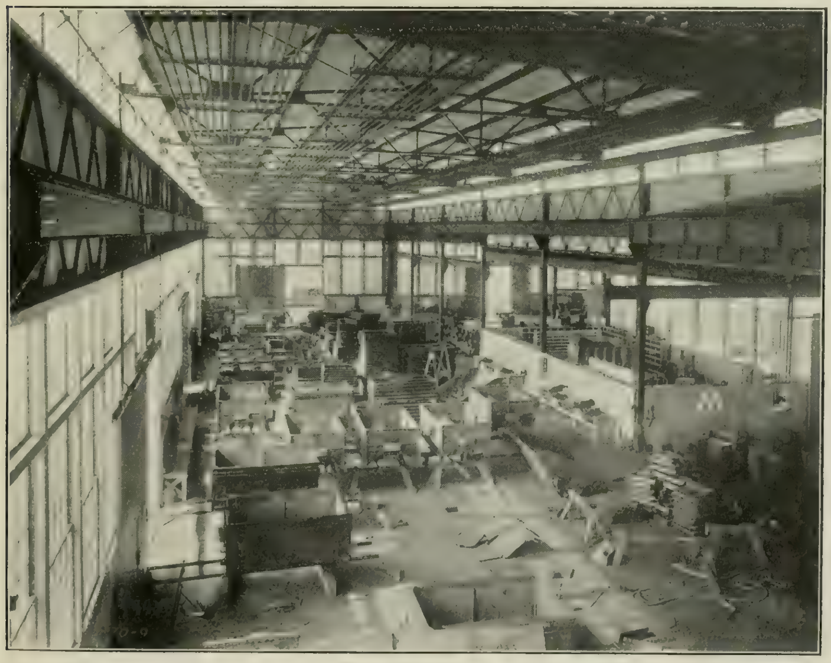


FIG. 7. INTERIOR BUILDING "E," ORENSTEIN-ARTHUR KOPPEL COMPANY.

The interior view of the erection shop, Figure 7, gives a general idea of the type of building construction that was used throughout the plant. The crane runways are supported on a steel frame which carries the roof. The cost of the side walls was minimized and at the same time admirable natural lighting procured through the use of a concrete base course extending from the footing up to a point 6 feet above the floors, and above this base course, extending from column to column, are the window frames, designed for balanced sash in the lower sections. In the case of the erection shop an additional row of tilting sash was installed above the crane runway. This type of construction eliminates entirely the usual pilasters between the window frames. The floors of the various shops are composed of 6 inches of bituminous concrete upon which is laid a 3-inch under floor covered with ⅞-inch factory-grade maple. The roof is composed of heavy plank laid on steel purlins and covered with a form of flexible roofing material.

The greater part of the finished product is stored prior to shipment in the yard directly in front of building "E," and a locomotive crane is used for handling it. A finished-product warehouse building "W" is also shown on the layout. The conclusion that one invariably reaches upon visiting this plant is that money has not been skimped in any particular that makes for economy of operation, whereas not a dollar has been spent for the sake of appearance alone. While this policy was undoubtedly the correct one to pursue in this case, it would of course be wholly inconsistent with the requirements of many other businesses.

SYSTEMATIC FOUNDRY OPERATION AND FOUNDRY COSTS.

By C. E. Knoeppel.

IV. PRODUCTION AND ITS DETAILS.

In the article inaugurating this series, published in October last, Mr. Knoeppel outlined the elements of the foundry problem. His second paper discussed thoroughly the very important question of depreciation as its comprehension applies especially to the profitable conduct of a foundry business. In December he took up the remaining elements to be recognized in foundry organization and accounting and defined the character and limits of each. His fourth instalment takes up the problems of production and the systematic treatment of the conditions that affect the actual productivity of the workman and the foundry.—THE EDITORS.

IT has been said many, many times, that the aim and purpose of a cost-accounting scheme, is *to increase production and reduce costs,* and unless these are the results, the arrangement must naturally be judged a failure; and because this has not been the attainment in so many instances, "cost accounting" is looked upon as something beautiful in theory but failing miserably in actual practice. The regrettable feature about it all is that there seem to be sufficient grounds for this feeling, notwithstanding the fact that there ought not to be.

A prominent foundryman recently told me that in the plant in which he is employed, elaborate accounting methods were devised and installed (at no small cost) and an elaborate force organized to compile accurate and detailed cost data (also at no small cost). He stated that results were made known so long after the performances covered by the records, that it was simply an impossibility for him or anyone else to point out reasons for certain fluctuations in costs; and that as a matter of fact, he knew more about what was going on before the introduction of the methods than he did after their installation. If this is not paving the way for a long string of excuses, enabling those responsible for inefficiencies to hide behind the much used "I don't know," then it would be a difficult task to ascertain what would be.

As has been stated before in this series—an accounting arrangement is a *recording* agency, not a *producing* agency, and if this recording is not a reflex of the existing conditions, then how can it be expected that one or a few men will know what caused this and what caused that? At any rate a close study has convinced me that accounting schemes fall down *because of the many things the cost statistics do NOT show.* Without questioning the theory of accounting, without doubting the accuracy of the recorded data, we must all agree that any system of records should show where the faults are, enabling the executive to go to his management with facts explaining the figures *instead of asking them to explain the figures by substituting the facts;* which by the way, are most elusive.

The reason for all this seems to be the underestimation of the complications in the foundry business by those responsible for the installation of improved (?) methods. The fact that foundry work is made up of four principal operations—moulding, core-making, pouring, and cleaning, is no indication that the proposition is as simple as many seem to think; but because of this seeming simplicity, or of lack of knowledge as to details, methods have been introduced in the hope that the conditions should conform to them instead of their conforming to the conditions.

The principal element in the foundry business is its production, and it has been a source of wonder to me, why the details of this production have not been analyzed to see if they could be made to submit to some sort of uniform procedure instead of something which could be viewed about as one pleased. It therefore seems advisable to take up the discussion of production details in an endeavor to make this recording a *constructive* as well as an *analytical* force.

WORKING CONDITIONS.—The first consideration is the conditions under which the work in a foundry is usually made, which as every foundryman will be able to appreciate, directly influence cost of production. A job may be made in an iron flask or in a wood flask that may have seen better days; it may be made in a flask of suitable size, or a flask may be used considerably larger than the work calls for. The pattern may be a mere skeleton which must be built up by the moulder before he can commence his moulding, or it may be a regular pattern, doing away with this extra work, or the pattern may be in the form of a sweep. One piece may be made in the flask, although it is just as likely that several pieces will be made in the same flask. The flask may consist of a cope and drag, or the drag may be dispensed with and the work made in a pit with a cope, or perhaps the cope and drag are both dispensed with and the work is made in a pit with loam plates for a covering, while for certain work we may see flasks consisting of drag, cheek, and cope. It may be that on certain occasions work is made on moulding machines, but because of congestion at the machines is made on other occasions by hand. The work may be bedded in a pit or in a drag, or it may be rolled as when copes and drags are used. One time the work may be made in green sand, another time the decision will be to skin-dry the mould, or perhaps the order will be to make a dry-sand mould. Loam and sweep work also enters into the consideration as regards cost.

From the above it can easily be seen how difficult it is to comprehend what a cost really means unless some information as regards the working conditions is at hand; for in a shop of any size, having quite a variety of work, it is safe to gamble dollars to pennies that after a period of a few weeks, no one can tell with any degree of positiveness exactly how the work was made or what really caused certain fluctuations in cost. To get this feature down to a basis that will admit of the working conditions being an open book at all times, the following classification can be used to advantage in correctly defining how a piece of work was made—the prefixed letters being the designating symbols for the various conditions:

METHOD OF MOULDING-
  G—Green Sand.
  S—Skin Dry.
  D—Dry Sand.
  L—Loam.
KIND OF MOULDING—
  B—Bedded.
  S—Swept.
  R—Rolled.
HOW MADE—
  M—Machine.
  H—Hand.
RIGGING—
  C—Cope only.
  DC—Drag and Cope.
  DCC—Drag, Check and Cope.
  LP—Loam Plates.
PATTERN—
  R—Regular.
  SK—Skeleton.
  S—Sweep.
  ..—Patterns to Gate. (Use correct numeral.)

(Designating Symbols for Conditions of Moulding; Continued.)

Flask—

M—Metal.
W—Wood.
..—Size. (List dimensions.)

If for instance a mould was made in dry sand; was rolled; made by hand; a cope and drag used; the work made from a regular pattern, two patterns to the gate; in an iron flask 5 feet by 3 feet by 2 feet 6 inches in size, the symbol would read:

DRH—DC—R2—M, 5×3×2-6

which would give anyone investigating the record a year from the time it was made, the exact facts in the case.

Delays.—Another feature which has never received a fraction of the attention it is entitled to is the matter of delays in the foundry, which are usually buried so deep in the cost figures as to be beyond all possibility of uncovering. Because of this I am of the firm opinion that the usual foundry accounting data cannot be anything else than inefficient because of the lack of clear and intelligible comparative evidence.

A moulder gets a job, we will say, and it takes him 24 hours to make it. According to the current practice, the moulding cost is $9.60, if the man receives 40 cents per hour. In this the correct cost? A moulder is hired *to make moulds*—not hired to do a great many things that he is oftentimes forced to do, which, in nearly every instance net the company absolutely nothing. If then in the 24 hours just mentioned, the moulder in question had lost any time for causes over which he had no control—causes which careful management could no doubt eliminate, *then the facts with their reasons should be properly recorded and classified,* for it is fair to neither the workman nor the job to tax it with what Mr. Emerson so aptly styles "preventable waste."

A point which it seems curiously difficult to bring to the understanding of managers accustomed only to "old-line methods" is that a large part of the gain obtained by efficiency methods comes from the elimination of these wastes. The skeptic as to "scientific management" has before his mind only the conception of driving the men to higher physical exertion. Efficiency methods, by reducing needless wear and friction, make the workman's task lighter instead of heavier. Actual acceleration of the workman's motions is the smallest part of the whole plan. Stimulative wage systems are the final step, and the least important as to exact method in detail.

Let us assume that the following is a time analysis of the job in question:

Number of Operation.	Operation.	Elapsed Time. Hrs.	Elapsed Time. Min.	
1	Getting sand in condition to start work............	..	40	(*)
2	Waiting on bottom board and drag................	..	15	(*)
3	Waiting on pattern..............................	..	25	(*)
4	Placing bottom board and pattern.................	..	15	
5	Placing drag....................................	..	10	
6	Ramming the drag................................	3	30	
7	Waiting on crane to roll drag.....................	..	25	(*)
8	Rolling drag over................................	..	10	
9	Making joint....................................	..	30	
10	Placing cope section of pattern..................	..	10	
11	Waiting for cope................................	..	20	(*)
12	Carpenters barring and chucking cope to suit the pattern..	1	25	(*)
13	Placing cope....................................	..	15	
14	Setting gaggers.................................	1	00	
15	Ramming cope....................................	4	00	
16	Waiting on crane to lift off cope..................	1	00	(*)
17	Lifting off cope.................................	..	20	
18	Drawing pattern drag side........................	..	30	
19	Drawing pattern cope side........................	..	40	
20	Finishing drag..................................	2	00	
21	Finishing cope..................................	2	30	
22	Waiting on cores................................	..	30	(*)
23	Coreing up mould................................	2	10	
24	Closing mould...................................	..	20	
25	Clamping and weighting..........................	..	30	
	Total elapsed time on mould.....................	24	00	

A study of this analysis reveals the fact that on starting the job in the morning, the moulder had to spend 40 minutes in cutting over his sand and getting it in condition for using. It then develops that he loses 15 minutes waiting for the laboring gang to bring in his bottom board and drag, after which because of some delay in the pattern shop, he is made to wait 25 minutes for his pattern. He then starts work and all goes well until he is ready to roll over his drag when he is forced to wait 25 minutes on account of the crane being in use elsewhere. After he rolls the drag and makes the joint, the next delay is 20 minutes, waiting for the cope to be brought to his floor. It is then found necessary to reset and chuck the bars of the cope so that it will suit the pattern that is being made, this taking 1 hour 25 minutes. He then works for 5 hours 15 minutes, placing his cope, setting the gaggers, and ramming, and when ready to lift off so as to begin the finishing of the mould, finds that the crane is in use by some of the other moulders and that before he gets it, one hour has elapsed. Things go along nicely until he is ready to core up, but because of the cores being not quite ready is forced to wait 40 minutes. Listing these delays and we have:

Operation No.		Hrs.	Min.
Operation No.	1—Getting sand in condition to start work...	..	40
“ “	2—Waiting on bottom board and drag......	..	15
“ “	3—Waiting on pattern....................	..	25
“ “	7—Waiting on crane to roll drag............	..	25
“ “	11—Waiting for cope........................	..	20
“ “	12—Barring and chucking cope..............	1	25
“ “	16—Waiting on crane to lift off cope........	1	00
“ “	22—Waiting on cores........................	..	30
Total time in delays..................................		5	00

As a result we find that in the 24 hours, the moulder spent only 19 hours on work that can rightly be classed as "moulding," and 5 hours in delays—a clear waste, or at least the greater part of it. Assuming that in the 19 hours the man worked he did all that could be asked of him, then the ratio between the total elapsed time and the actual moulding time of 19 hours, is 78.5 per cent, consequently the loss or inefficiency of 5 hours is 21.5 per cent. If however the job had been standardized as a 15-hour job, then the efficiency would be but 62.5 per cent and the inefficiency of 37.5 per cent divided as follows:

Fault of the moulder.............	16.0 per cent.
Fault of the management..........	21.5 per cent.

If, however, the cost of the work is compiled on the basis of the 24 hours (as it no doubt would be) and is noticed on account of the length of time that was taken, we are virtually charging the inefficiency to the moulder, for after the costs are compiled *who in the place knows anything at all about the delays on this particular job?* The result is that the management attaches absolutely no blame to itself; the inefficiencies are lost sight of and the cost record filed away after the customary—"don't let it happen again." A statement of this kind, in the absence of pointing out any specific happening whose recurrence it is expected to avoid, is like asking a child to pick up something it did not drop.

Men should be encouraged to report delays that are preventable or for which they are not to blame, in order that they may be properly classified so as to *force action* in the direction of bettering conditions to eliminate the majority of delays that are usually met with in the foundry, which can be eliminated if the proposition is approached in the right spirit.

Productivity.—It is essential in any undertaking to know as much as possible about what is being accomplished, but it is equally important to have this knowledge condensed in as brief a form as will correctly convey the desired information. In the foundry business we deal to quite an extent with *weight*, and because of this fact the tendency has been, and is now, to indulge in too much consideration of "tonnage." Tons, tons, and more tons is the eternal cry; consequently who can blame the usual shop management because it suffers from "failing memory" as regards *light stuff* which cuts such a small figure in increasing tonnage; because it crowds work oftentimes regardless of cost; because it puts five or six men ramming a cope, in order to get the job out with a rush, when two men or three at the outside could work to decidedly better advantage.

Many an executive is perfectly satisfied when his statement shows a high tonnage for the reason that it is usually accompanied by a low relative cost and as a result it is considered that the attainment is up to the mark. It may sound very, very strange, but *it is this one feeling of satisfaction over high tonnage that has proven such a stumbling block in the way of attaining the highest efficiency in the foundry.* A large tonnage *because it is large* is in itself a direct factor in bringing about a reduction in cost, oftentimes regardless of any other consideration, and because of this fact it is a very easy matter for the inefficiencies to be lost sight of. Men may be working to disadvantage; the planning of the work may not be all that it should be; materials may be used recklessly; rigging may be used without much regard to its adaptability to the work; and yet "when the returns are all in," a high tonnage at a low cost overshadows the defects in the existing scheme of things. Reflection should show that it is possible for an inefficient shop to do a business at a profit so long as its tonnage can be kept above a certain figure, but once let it drop below the balancing point and an investigation of the inefficiencies is immediately in order. The trouble is that there is too much consideration given to figures in the aggregate—the final results; and as was pointed out in the introductory paper, the usual study of things begins at the wrong end—the top instead of the bottom.

To reverse the usual order of things, to be in possession of knowledge in condensed form, that will show how things are progressing, it is necessary to decide upon some unit that will convey more meaning than is usually conveyed by the final tonnage and cost statements. The law of cause and effect may help us. Production is the result of the work of the men who make it. Why not hitch the two elements together—the production *in pounds* and the work of the men *in time,* calling the ratio that it is impossible to ascertain, *productivity* —which would mean the relative amount produced in a given time? This would seem a logical unit for two reasons:—

1—Because the amount that a man produces in a given time is the basic factor determining the cost of what he produces.

2—Because it furnishes a unit of comparison as regards accomplishment.

The importance of the first reason will be appreciated upon consideration of the following:—

Case.	A.	B.
Weight of casting	250 lb.	250 lb.
Produced in given time (ten hours)	1,000 "	1,500 "
Labor rate per hour	$0.30	$0.30
Cost of the total amount produced in the ten hours	3.00	3.00
Cost of the total amount produced per 100 lb.	.30	.20
Cost of the 250-lb. casting then becomes	.75	.50

NOTE—For a further discussion of productivity see the November, 1908, article of this series, on "The Importance of Correct Burden Apportionment."

As regards the second reason. Assuming the casting in cases A and B to be from the same pattern, it is evident that in the same length of time, the production at B was increased 50 per cent over that shown at A, consequently the man who made the six castings is a better workman than the one who made the four castings; or if the same man made the work, his productivity was better in one instance than in the other. Our unit of productivity takes into account the importance of both 1 and 2, whether the test is applied to a single casting, a group of castings, a division of the production, or the total amount produced.

The unit can best be expressed in terms of *pounds produced daily* and the rule would be:—

M = Hours of moulding.
W = Weight of casting in pounds.
H = Hours to the working day.
P = Productivity.

$$\frac{W}{M} \times H = P.$$

Some attempt has been made in a number of foundries to use this unit in getting at facts concerning production but it has been found that a decided difference of opinion exists concerning the elements making up the unit. The time element has been found in certain cases to be:—

1.—The hours of moulders *only*, disregarding special laborers working as moulders, apprentices and laborers directly assisting moulders.

2.—The hours of moulders, special laborers working as moulders, apprentices and laborers directly assisting moulders.

3.—The hours of moulders, special laborers and apprentices laborers not included).

4.—The hours of moulders and coremakers because their time is considered a part of Direct Labor.

It naturally follows that each one of the four elements if used will give different results. One foundryman using No. 1 will tell another who may be using No. 4 that he is producing 1,000 pounds per man per day, and the second will say that he is getting 800 pounds per man per day. Both may be producing about the same amount, but the difference in the element used seems to make the practice of one foundryman much better than that of the other. If consideration is given to No. 1, it will be found that the relative expression of productivity is not absolutely correct; for while the moulders may be producing a certain amount, others have assisted the moulders to a greater or less degree in turning out the production, and the time of this assistance is as much a part of the producing time as that of the moulders themselves. As for No. 4, it will be apparent upon consideration that core-makers do not influence production as far as the core labor is concerned. The core setting by the moulders is of course a part of the producing time, the result of which is castings. Core labor, however, produces nothing of a tangible nature, and as the aim of our unit is to get at the relation between what is produced and the time in which it is produced, it seems reasonable to exclude the time of core-makers from our consideration of productivity. This leaves No. 2 and No. 3, either of which can be used, depending upon the policy in any certain shop, the procedure being as follows:—

1.—If the policy is to assign a laborer as a regular assistant to the moulder, then the time element should include the time of the laborer.

2.—If, however, the gang of laborers is a floating body, their time can be left out of the consideration.

It may be well to state in connection, that while the terms *productivity* and *efficiency* are in a sense synonymous, the above remarks on productivity must not be construed as meaning that considerations of efficiency are to be relegated to the rear. Efficiency, as was pointed out in a previous paper, is the ratio existing between the estimated or possible performance and the actual attainment. A standard producing time against the actual producing time; the possible production against the actual weight produced, will give the relative degree of efficiency as to time or weight. The productivity ratio, however, considers *actual attainments only* and merges two *different* elements—production and time—instead of the same elements, so while there may seem a sameness in the terms, there is after all a difference in the two units of comparison. In papers to follow the importance of both efficiency and productivity, in their relation to the foundry industry, will be dwelt upon at greater length.

Average Weight of Castings.—Another unit which can be used to advantage is the consideration of the average weight of what is produced in a given period and this can be employed with special reference to productivity. We sometimes hear that the reason for a high cost of production is the light work made, or if the cost is a low one, heavy work is given as the reason. The following rule will therefore give some information which may prove of value:—

W = Weight of the castings produced (in total or by classes).

N = The number of pieces made.

A = Average weight per piece.

$$\frac{W}{N} = A$$

It is a good thing to know that in a certain period of time the productivity was 800 pounds per man per day, while in another it was 1,000 pounds per man per day, but if in the first period it was found that the average weight of the castings was 800 pounds and 500 pounds in the second period, our information, which would naturally include a knowledge of the class of the work made, would be much more complete.

Classification of Production.—A general policy of classifying production should be adopted, along the lines suggested in the fifth paper of the previous series entitled "Apportioning Costs to Production in Various Classes of Foundries." To each one of the classes, a symbol should be given for use in charging and identifying the various classes. I doubt very much if it is advisable, except in extreme cases, to classify according to the individual pattern as this makes the costing altogether too elaborate and cumbersome, but I do believe in classifying by main classes having a limited number of subdivisions, with a proper provision for getting the production cost of any particular patterns if desired.

REINFORCED-CONCRETE BOILER SETTINGS.

By W. H. Weston.

In Mr. Weston's article, definition of practice rather than discussion of principles is the major purpose. In substance, he gives general working specifications for construction of the kind indicated by the title of his paper. His authority is derived from 18 years' experience in civil and mechanical engineering, including railroad work, steam-power plants, and waterworks.—THE EDITORS.

REINFORCED-CONCRETE boiler settings have not so far received very much attention from manufacturers and steam-power users, probably because owners and operators are waiting for what they consider the necessary experiments to establish the thing successfully as a valuable substitute for the present brick settings.

But the matter is not surrounded by difficulties of any kind, and there is no reason why these settings cannot be effectively built and used to advantage at the present time if the project is taken in hand in a practical way, and the knowledge that has already been gained about reinforced concrete is used. A setting built without any regard to the elements involved could not be expected to prove satisfactory in actual work.

Quite a large number of these settings have been installed, but of course the number is very small in comparison to the total of steam plants running. Reports from a number of the places where concrete is in use show a great range in the methods of construction and in the design of details, which indicates that many of them were built without much attention to the fundamental principles involved. But even at this, most of them are proving satisfactory to varying degrees, and it has not in any way been shown that a concrete setting cannot be made a success and an advantage in steam-plant construction. The matter sums up here, as in other things—in the long run, what will be the financial gain?

Many people apparently have the impression, when this kind of a setting is suggested, that it is intended to make the whole thing of concrete, and that the inner surfaces are to be exposed to the fire; but of course with any kind of concrete as made at present such a construction is impossible. Fire-brick lining must be used as it would be for an ordinary brick setting, this being no disadvantage as far as the concrete part of the work is concerned.

There seems to be but little doubt that some of these settings in use at the present time were made of poor materials, that is, the materials although they might have been very good for ordinary purposes were not well suited to this work, and in other instances where the materials were all right and properly suited to the work, the proportions making up the mixture of concrete were not what is required to have the setting give the best results in actual service. These things are of very great importance in the matter and must be carefully and intelligently looked after to obtain satisfactory results.

Concrete made with gravel, even if the gravel is of the best as far as other uses are concerned, will not resist heat nearly as well as that made with trap rock; gravel concrete may at times crack and crumble where a hard trap-rock mixture will stay firm and solid. All soft rock must be avoided in the crushed stone, and also all limestone or rock of a similar nature.

The hardest and densest concrete usually conducts the least heat, and offers the greatest resistance to high temperatures. The sand should be clear and clean and have no admixture of vegetable or organic matter, clay, etc., and the particles must be free from any coating or film of dirt. When necessary the sand must be thoroughly washed. A uniform fine sand should not be used; one in which the particles range in size from those of fine sand to grains about ¼-inch is the best.

As to the size of the trap-rock properly suited to this work, it may be said that stone ranging between ½- and ¾-inch is preferable, and nothing larger than ¾-inch should be used. A first quality of trap rock should be had even if it must be shipped a long distance, because the close, dense grain, toughness and strength, make it more valuable than any other stone. Limestone, conglomerates, sandstones, etc., should not be used.

In any situation where trap rock cannot be had without involving too much expense, cinders may be used, although they are not to be commended as equal to broken stone. If cinders are used they must be of first-class quality; that is, the combustible matter must have been thoroughly burned out, and they must be free from dirt and soot. Ordinarily they should be screened to avoid these latter objectionable elements, and the cinders must be so broken that no piece will measure more than 1 inch the largest way.

The proportions in the mixture for a boiler setting should be one of cement, two of sand, and four of stone; larger proportions of sand and stone should never be used.

If the concrete is to be made by hand, the cement and sand should be mixed together dry, the stone then added, and the necessary quantity of water supplied, all the mixing of materials dry and after wetting being done in the most thorough manner, the materials being turned over a sufficient number of times to produce a uniform mixture, the stone, sand and cement being evenly distributed throughout, and all surfaces of stone and sand thoroughly and evenly coated with cement and the whole mass uniformly wet. The water used must always be absolutely clean. The cement may be any of the standard brands of Portland.

As to the details of the setting, these can of course be varied more or less to suit given conditions, or form of boiler. But a study of a majority of those so far built gives a fair average result for common tubular boilers thus:

First; the walls are double, with an air space 3 to 4 inches wide (4 is preferable).

Second; the inner wall is about 5 inches thick (6 would be better) and the outer one 6 inches.

Third; both inner and outer walls are reinforced, and tied together.

Quite a variety of reinforcement has been used, but probably the best method is to use either 3/8-inch steel 5 inches on centers, both horizontally and vertically, or 7/16-inch steel 6 inches on centers. Short pieces of steel are placed transversely across the air space at the same spacing as the other steel, care being taken that the ends of these pieces do not come within 1 1/4 to 1 1/2 inches of the inner side of the inside wall. If the setting is properly built this will make ample reinforcement, give sufficient strength, and prevent cracks. Such reinforcement is simple, cheap, easily placed, and makes a good and satisfactory job when done.

With boilers of such design that the walls of the setting will be very high it would probably be necessary to build them somewhat differently from those for a tubular boiler, that is, in the matter of thickness and of reinforcement, and especially so if arches are to extend over the top of the boiler or any part of it that might cause a thrust.

A 4½-inch fire-brick furnace lining should not be used because on account of its thinness it must be bonded into the setting, and when it comes to the point where the lining needs renewing this bonding is a nuisance. On the other hand a 9-inch lining is thick enough to stay well in place without any bonding, and when it comes to renewing it, this can readily be done, for it is all straight work, and as there is no bonding the old lining can be torn out easily. This renewing of the fire-brick must of course be done whether the setting is concrete or brick. And another point is that a 9-inch lining is far better than a 4½-inch because it is heavier and more substantial, and also because it will not transmit as much heat to the outer setting. When the cost of tearing out and resetting a 4½-inch bonded lining is aken into account, it will be found that a 9-inch without bonding costs no more to build and reset, and in the long run that the latter is the cheaper because it will stay in commission longer.

Ample clearance should be had at the ends of the lining to allow for expansion.

When building around an economizer the double wall with air space is of course not necessary; a 5-inch wall reinforced the same as the 6-inch outer wall of the main setting with pilasters at the corners is sufficient unless it is intended to carry mechanical-draught equipment; if so, additional pilasters properly spaced must be used.

The corners of a single boiler setting, or those of the outer walls of a battery, should have pilasters 12 to 14 inches wide and about 15 inches thick at bottom; all pilasters to be reinforced.

In estimating the cost of a concrete boiler setting some allowance must be made for the locality, as the prices of labor and materials vary so much in different parts of the country. But taking a fair average, with a few exceptional localities left out, the price of the concrete part of the setting per cubic yard would be between $10 and $12, this price including the cost of the forms and of the reinforcement, or in other words, the total cost of the concrete complete in place. In figuring the volume of the concrete, the air spaces are to be figured in as though they were solid, and at these figures the total costs of a concrete and of a brick setting are about equal.

As stated before, the fire-brick lining must be used with either kind.

The cost of fire brick varies in the extreme from about $15 to about $45 a thousand, the variation usually being between $17 and $25, and a fair average price being $20 a thousand. At this figure the total cost of brick in place would average from $30 to $35 a thousand.

As to the comparative costs of a concrete and a brick setting it has been shown that the first cost averages practically the same. But in the long run the concrete will prove the cheapest, because if properly built it does not deteriorate so much as the brickwork, and it does not require the amount spent for repairs that is usually necessary to keep a brick setting in good condition.

The foundation for a boiler setting can invariably be made of concrete cheaper than of stone, and at the same time it makes a better one than those of random stone as usually built. And if an ash-handling plant is to be installed, the advantages of using concrete for this part of the work are its durability, and that it will cost less than brick or stone construction. Unless there is something especially complicated about it, such work can be done complete in place, including cost of forms, material, labor, etc., for about $8 per cubic yard. On some jobs it might run up to $10, even if the construction was fairly plain and simple, but $8 is probably a fair average for such work in most places, this price including the moderate amount of reinforcement needed.

Another advantage in using concrete for a boiler setting is the fact that at the present time it is being used to such a great extent in the construction of manufacturing plants that it is readily available for the boiler settings, and because the large amount of experience that has been gained in concrete work makes it a comparatively easy matter to adapt it properly to this purpose.

MINERAL RESOURCES OF THE JAPANESE EMPIRE.

By Dr. A. Selwyn-Brown.

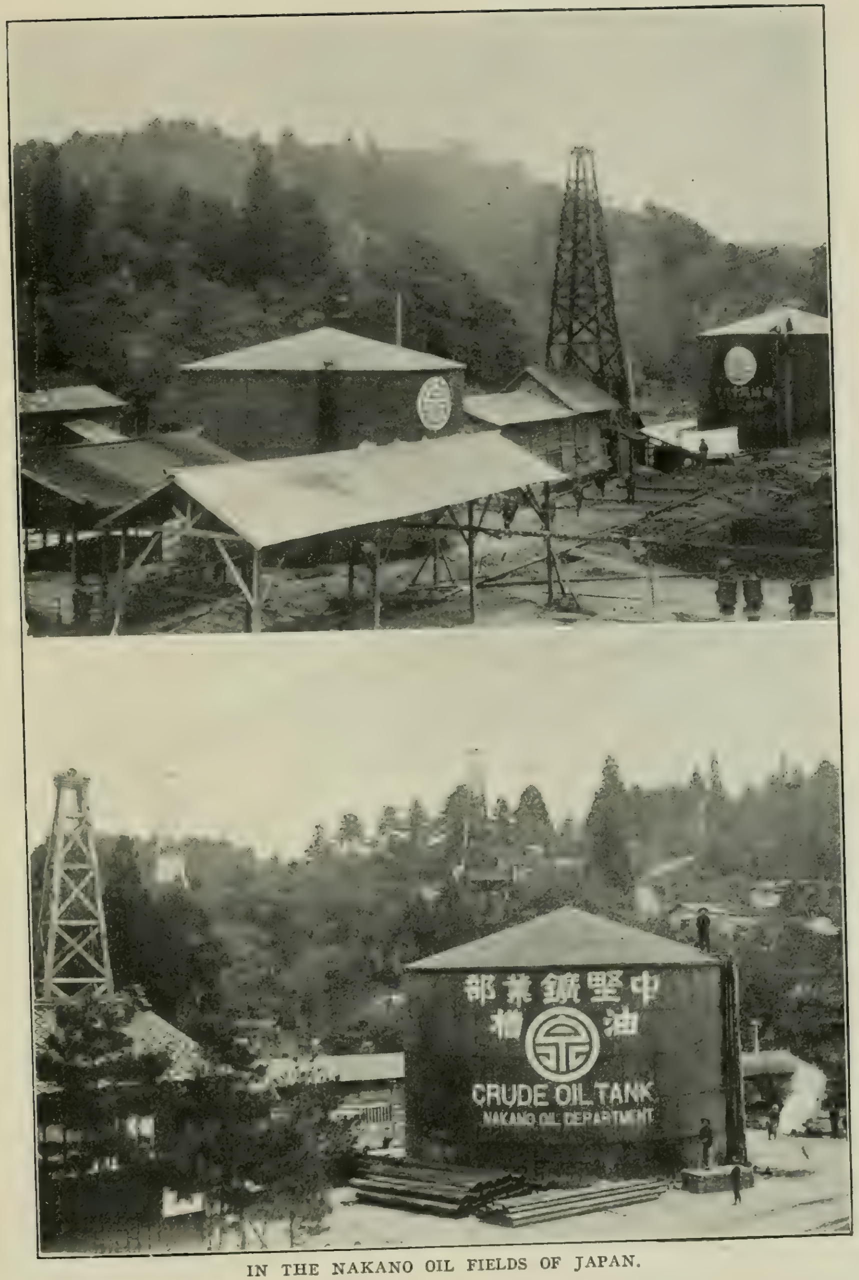
In the following article Dr. Selwyn-Brown completes a review of the Japanese mineral industries, prepared from collated official and authoritative sources, and presenting a unique survey of the entire subject. It is of much importance in view of the growing claims of Japan to industrial rank. The former part, published in December, covered the resources and production of the Empire in copper and gold, with a digest of Japanese mining law.—The Editors.

THE Japanese recognize that their agricultural resources are limited on account of the peculiar topographical and climatic features of the country. The agricultural land has been subjected to intense culture for centuries and cannot be improved much more. The Empire is thus precluded from becoming an important contributor to the world's food supplies. It will do well if it can manage to produce sufficient food products for its own use. When the population increases, it will necessarily become dependent upon foreign countries for food. Consequently, the administrators have for some years aimed at making Japan a manufacturing and shipping country. They have taken England as a model in doing this. Japan is not nearly so well endowed with natural resources as England is, but the progress lately made in developing Japan's shipping and manufacturing industries is remarkable.

It is almost essential for a nation aspiring to rank well among the great manufacturing peoples to command extensive resources of coal, iron, salt, the alkalies, petroleum, limestones and clays. Japan, fortunately, possesses an abundance of such resources and is therefore naturally equipped for becoming what her political leaders are striving for—the leading industrial country in the Orient.

COAL.

The coal resources of the Empire are extensive and statistics show they are undergoing a steady development. The collieries at present in operation have a greater capacity than is required for producing the quantity of coal needed for home consumption. An extensive export business in steam coals has, therefore, been built up with Chinese, Philippine, and South American ports. The annual production of coal in Japan since 1890 is shown in Table I.



IN THE NAKANO OIL FIELDS OF JAPAN.

TABLE I.—COAL PRODUCTION IN JAPAN, 1890-1909.

Year.	Long tons.	Year.	Long tons.
1890	2,608,284	1900	7,370,667
1891	3,175,844	1901	8,884,812
1892	3,175,670	1902	9,588,910
1893	3,319,601	1903	9,978,649
1894	4,268,135	1904	10,602,008
1895	4,772,654	1905	11,817,352
1896	5,019,690	1906	12,845,315
1897	5,188,157	1907	13,736,182
1898	6,696,033	1908	14,688,659
1899	6,721,798	1909	15,400,000

Workable coal seams occur right through Japan from Formosa to Saghalien and Corea. Coal is found in 43 of the 49 Prefectures of the Empire, including Saghalien and Formosa. It is estimated by the Geological Survey that the coal areas comprise over 1,000,000 acres of workable steam coal and 25,327 acres of useful lignite deposits.

The most valuable coal fields at present mined are situated on the small Island of Kyushu. The coal fields of Hokkaido, Honshu, the Southern Islands and Saghalien come next in order of importance.

The Japanese coal formations range in age from Mesozoic to Tertiary Times. Bituminous, semi-bituminous and semi-anthracite coal is mined. The seams are generally small and much disturbed by faults and by intrusive igneous-dike rocks. The coal is rarely of high grade. It is mostly a dirty steam coal rich in ash and sulphur.

The composition of the best Japanese coals is shown in Table II.

TABLE II.—COMPOSITION OF JAPANESE COAL.

Field.	Colliery.	Water.	Volatile Matter.	Coke.	Ash.	Sulphur.	Coking qualities.	Specific Grav.
		Per ct.	Per ct.	Per ct.	Per ct.	Per ct.		
Chikuho	Shinnyu 3 ft. seam.	3.41	42.76	48.46	5.37	0.22	Good	1.311
"	Akaikie 5 ft seam.	2.64	43.99	50.44	2.93	0.41	"	1.275
"	Namazuta	1.66	42.50	52.68	3.16	0.81	"	1.298
"	Miike 8 ft seam.	0.70	42.15	48.85	3.30	3.34	"	1.278
Hizen	Takashima	0.98	39.08	53.42	6.53	0.65	"	1.270
Ishikari	Yubari	1.46	42.89	57.11	4.57	0.31	Fair	1.200
"	Poronai	5.09	42.19	48.80	3.92	0.25	"	1.306
Hitachi-Iwaki	Shiramizu	5.06	44.36	40.81	8.75	1.39	Bad	1.304

THE KYUSHU COALFIELDS.

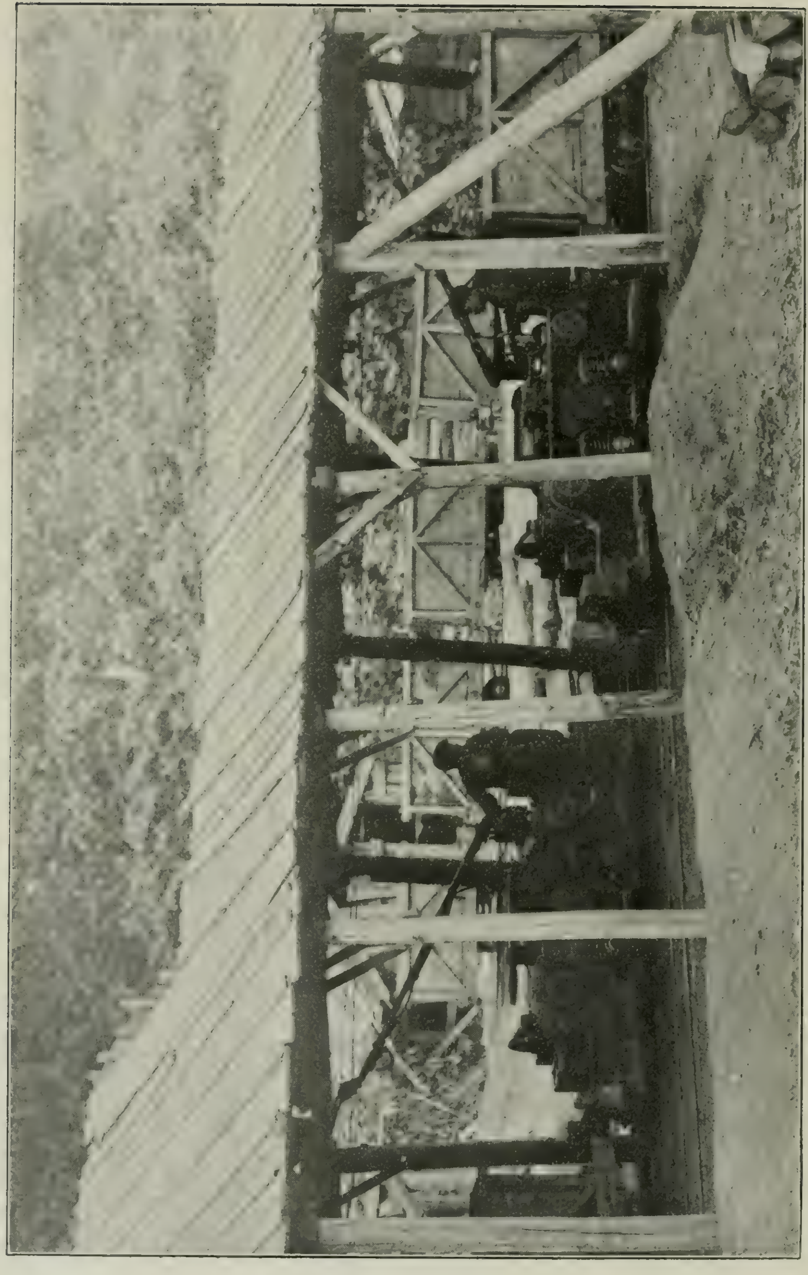
The principal coalfields in Kyushu are in the Fukioka, Saga, Nagasaki, and Kumamoto Prefectures. The Miike, the most productive field, is located near the seaport of Omuta, on the east side of Ariake Bay. The field has an area of about 30 square miles and is owned and operated exclusively by the Mitsui Mining Company.

The Miike coal beds are of Eocene age and are situated between shale and sandstone. Two seams are worked. One seam averages 6 feet and the other 8 feet in thickness. It is a bituminous coal containing about 50 per cent carbon, 40 per cent volatile matter, 6 per cent ash and 4 per cent sulphur as it comes from the mines. When it is hand picked, washed and screened, it assays, of course, better and gives results like those in Table II.

The Mitsui Company is operating six large collieries on this field and is doing a large amount of prospecting work with Calyx drills. The upper seam on the Miike field has a sandstone roof that lets in the sea water so that the colliery workings are very wet.

The coal is mined by shafts, the deepest of which is about 1,000 feet. The pillar-and-room system is employed in breaking out the coal. The worked out portions of the mines are filled in with stone-wall work filled with a mixture of mud dredged from Miike Harbor, crushed sandstone and boiler ashes. Little wonder rock drills are employed in drilling in stone-work and experiments are being made with various types of coal-cutting machines. The Manda colliery is the largest of the Miike group. The coal in this mine is worked through an inclined shaft 2,000 feet in depth. It is the wettest of Japanese collieries. The manager estimated that 10 long tons of water have to be baled out of the mine for every ton of coal mined. This immense inrush of water is handled by many types of pumps. The following pumps do most of the pumping: Three Davey 45 inch — 90 inch 22 foot by 12 inch differential; one Davey 45 inch — 76 inch by 22 inch by 70 foot differential; four 23 inch — 60 inch by 16 inch by 4 foot compound duplex Jeanesville; four 13 inch by 12 inch Knowles three-throw electric; one 6 9/16 by 11 13/16 electric Schleifmülle; three 10 inch Sulzer turbine; two 12 inch Sulzer turbine; thirteen 9 inch by 10 inch three-throw Sulzer electric and one 4½ inch by 5 inch three-throw electric. These pumps require 9,000 horse-power to operate them. The output of the mine is about 2,000 long tons of coal per day.

The company's other mines are furnished with similar pumps. Guibal, Sirocco, Walker and Champion fans are used for ventilation. The capacities of the fans range from 90,000 to 120,000 cubic feet



ELECTRIC LOCOMOTIVES, HOKKAIDO COLLIERIES.

of air per minute. Lancashire and Babcock and Wilcox boilers are used for steam generation and the electric plant contains five Curtis turbo-generators. The steam-power capacity of the power works is 21,000 horse-power and the electric power averages about 5,000 horse-power. Work is found on the company's mines for 11,000 men and the annual production of coal is between 1,500,000 and 2,000,000 long tons. The company built an important harbor comprising 130 acres at Miike by means of concrete breakwaters. It is capable of permitting four 10,000-ton steamers to load coal per working day. This harbor is completely equipped with the latest appliances for automatically loading and stowing coal cargos.

The Chikuho coalfield is situated due north of Miike, and a little south of the port of Wakamatsu. The geological features of this field are similar to those at Miike. They really appear to be parts of one field that have been torn apart by a mountain uplift. There are numerous seams of coal in Tertiary, sandstone, slate and conglomerate formations. Over thirty collieries owned by various companies are working on this coalfield. The seams are mined by shafts and slopes. The slope in the Shin-Nyo mine is 5,400 feet in depth. The worked seams are from 4 to 6 feet in thickness and are mined by the pillar-and-room method. All the collieries are well equipped with ventilating and mining machinery.

The Saga coalfields are situated in the Hizen province, east of Miike. The geological features on these fields are also similar to those at Miike. All the coalfields in the western portion of the Island of Kyushu appear to be of the same geological age. They merely differ in their topographical aspects, and in the rock formations that prevail. These fields include the Miike, Kasuga, Chikugo, Saga, Nagasaki and Amakusa coal mining districts.

The Hokkaido Coalfields.

The second important division of the Japanese coal resources comprises the Hokkaido deposits. These include the Ishikari, Rumoi, Haboro, Wakanai, Poropets, Makunpets and Akkeshi fields. The principal collieries are working on the Ishikari field. This is situated in the province of the same name and a little east from the port of Sapporo. The field covers an area of about 600 square miles. The coal seams are in shale and sandstone country of Eocene and Miocene age. The numerous workable seams run from 2 to 5 feet in thickness. The coal is bituminous and averages 35 per cent volatile matter, 55 per cent. carbonaceous matter, 5 per cent ash and 0.5 per cent sulphur.

URASE OIL FIELDS, (HIGASHIZUMA) OF JAPAN OIL CO., ECHIGO.

The largest colliery now in operation is the Yubari. It has two working shafts cutting three coal seams. The main seam is 5 feet thick with bulges running up to 20 feet in thickness, and two 4 feet seams are mined. The pillar-and-room method of mining is employed here, as on most of the Japanese coal fields. The long wall system is rarely attempted owing to the broken nature of most of the seams. American rock drills and coal-cutting machinery and Guibal and Champim ventilating fans 20 feet in diameter are used at this colliery. The miners are furnished with the latest types of Wolf and Clanny safety lamps. The Japanese coal-mine inspectors strongly prohibit the use of the open lights in collieries that cause so many explosions in American mines.

The Yubari machinery is driven by steam, electric and pneumatic power. Lancashire and Babcock and Wilcox boilers are used as steam generators and Parson's turbines generate the electric power. The mine produces from 600,000 to 800,000 tons of coal per annum.

THE HONSHU COALFIELDS.

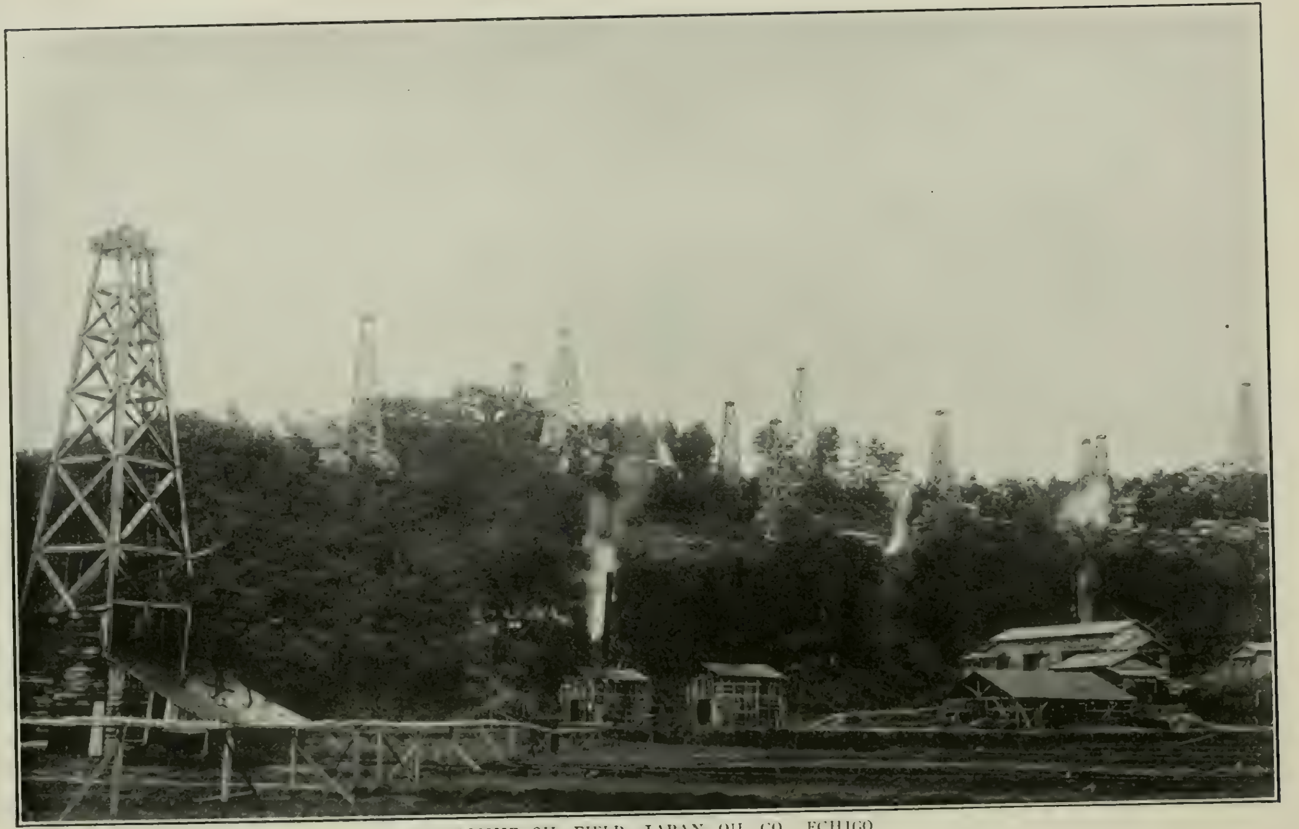
The coalfields of the Main Island are chiefly those known as the Fukushima, Ibaraki, Yamaguchi and Wakayama fields. There are several seams of Tertiary coal on these fields; but only two seams are worked. The coal is much disturbed by faults and igneous dikes. It is of poor quality and in places is almost a lignite. The ash runs from 8 per cent to 17 per cent and the sulphur content is about 2.5 per cent. The coal is principally used in lime-burning and in cement-manufacturing works.

The Japanese Navy officials are developing the Omine collieries on the Yamaguchi coalfield, with the view of raising coal for naval supplies.

THE SOUTHERN ISLANDS COALFIELDS.

Coal is mined in small quantities in several districts in the western and northern parts of Formosa and on the small island of Hokuto on the west coast. The coal is of Tertiary age and the seams are numerous. Three small seams between 2 and 4 feet in thickness are now being mined. The coal is bituminous and contains about 49 per cent carbon, 40 per cent volatile matter, 3.5 per cent ash and 2.5 per cent. sulphur.

The annual output of the collieries in Formosa is about 350,000 tons per annum. A good deal of development work is being done on the Formosa coalfields, and they promise to be of greater importance in the future.



NAGAMINE OIL FIELD, JAPAN OIL CO., ECHIGO.

Coal of a similar quality to that mined in Formosa occurs in the Loochoo Islands and in Saghalien. Very little mining is done either in the Islands or in Saghalien. The Saghalien deposits are promising but development operations are handicapped by bad transportation facilities and by the rebellious spirit of the people.

KOREAN COALFIELDS.

Numerous coal deposits are known to occur in the Mesozoic and Tertiary formations in many parts of Korea. A good class of anthracite is mined near the city of Phyong-Yang.

Bituminous seams have been opened along the railroad near Saruion and Thong-Sin. Lignite and peat deposits have also been discovered. Little attention has hitherto been given to the development of coal mining in Korea, but now that it is a Japanese province it will be actively developed and a demand will be created for local coal.

From this brief survey of the coal resources of Japan, it will be noticed that coal is widely distributed and mined throughout the Empire. The quality of the coal is not so good as the average American or European coal; but it is good enough for most industrial purposes. The collieries are mostly owned by large companies and are worked in a substantial manner. They are equipped with the latest types of American and European machinery and particular care is taken to ventilate the mines and thus prevent explosions and loss of life. In this respect the Japanese coalfields are in advance of the best American fields. The known coalfields in Japan contain sufficient coal to support the Empire for centuries, but care must be taken not to permit the exportation of coal to foreign countries to increase much. The natural resources of the Empire must be strictly conserved if the government's ambitious plans are to succeed.

SILVER AND LEAD.

Silver and lead deposits are found in many localities in Japan, but there are only a few important mines yielding these metals. Their total production is about 4,000,000 ounces of silver and 3,000 tons of lead per annum.

The principal silver and lead mines are the Tsubari, Ikuno, Innai and Kamioka. The Innai and Ikuno mines are the largest producers. The Innai is situated in the Province of Yamagata, on the Main Island. The ore occurs in a quartz vein traversing the intersection of an andesite with a volcanic tuff formation. It is a complex ore calling for skilful metallurgical treatment. It carries gold, silver, galena, zinc, pyrites, chalcopyrite and a little cinnabar. The mine is extensively developed by shafts, the deepest of which is 1,500 feet. The ore is crushed, classified and concentrated at a mill on the mine and smelted. The annual output is about 12,000 tons of ore yielding 1,000 ounces gold, 95,000 ounces silver and 300 tons of copper per annum. The lead and zinc concentrates are shipped to other smelters.

The Ikuno is an old and famous property. It is situated on a mountain in the Province of Hyogo, on the Main Island, and about midway between the cities of Kobe and Tottori. The ore is found in quartz veins in a formation similar to that of the Innai vein. This ore is also complex, but the various minerals are banded so that it is possible to mine one part of the vein at a time and get the bulk of the copper, lead or silver as desired. When the miners work forward on the copper they work back on the lead-bearing portion of the vein. This saves a lot of trouble and expense in concentration.

There are a large number of shafts on this mine, which is really a series of mines on a single field. The deepest shaft is about 1,000 feet. Lidgerwood hoists are employed for hoisting, Worthington pumps for boiling, and Jager drills in mining.

This mine possesses an extensive crushing, concentrating and smelting plant furnished with American and English machinery. The annual output is about 30,000 tons of ore, yielding 4,000 ounces of gold, 200,000 ounces silver and 1,000 tons of copper per annum.

The yearly production of silver in Japan is about 4,000,000 ounces. About 3,000 tons of lead are also produced. This is not sufficient for the needs of the country and between 8,000 and 12,000 tons of lead are annually imported from the United States and Australia. Large quantities of manufactured lead articles like tubes, sheets, and tea-lead are also imported from Great Britain.

Lead occurs in many part of Korea. About fifty years ago several native mines produced the ore, but lately very little lead mining has been done in that country.

ZINC.

Ores containing zinc blende occur throughout the Empire. Many of the richest deposits are unworked on account of the lack of efficient transportation facilities.

The Kamioka mine, situated in the Province of Hida, west of Tokyo, and south of Toyama, is the largest zinc producer at present. The ore is mined from irregular pockets, or lenses, in a limestone formation lying on Archæn gneiss. It consists of a mixture of argentiferous galena, zinc blende, pyrite, and chalcopyrite. The average contents are 5 per cent lead and 12 per cent zinc.

NO. II OIL REFINERY, JAPAN OIL CO., KASHIWAZAKI, ECHIGO.

The ore is crushed, jigged and concentrated by hydraulic and magnetic methods. Experiments are being made with some of the flotation processes of concentration that are yielding such satisfactory results on the Broken Hill field in Australia, and it is probable that the metallurgical plant will be renovated and enlarged shortly.

The annual output of this mine is about 90,000 tons of ore, 300 ounces gold, 200,000 ounces silver, 40 tons copper and 10,000 tons of zinc concentrates. It employs 3,000 men.

Zinc deposits occur in Korea, but like the lead deposits, they are unworked at present.

The total production of zinc ore in Japan is about 20,000 tons per annum, valued at $200,000. About 8,000 tons of metallic zinc and zinc bars, sheets, tubes and other manufactured shapes are annually imported by Japan from foreign countries.

IRON.

Numerous iron deposits are known to exist in Japan; but little attention has been given to iron mining. The ores are of various kinds. Deposits of magnetite have been opened up and tested in 27 provinces. Micaceous iron ore is mined in the Akadani mine, situated 32 miles east of the city of Nugata. This mine is owned by the Government and is being developed on an extensive scale. Bog iron ore, hematete, and iron sands are found throughout the islands.

Japan imports about 500,000 tons of iron and steel products, valued at $20,000,000 annually. Its iron mines yield only 200,000 tons of ore and 40,00 tons of pyrites per annum. It appears that the Japanese iron-mining industries have been retarded by lack of capital and competition of European, Indian and American iron smelters. The prices of iron and steel in the Oriental markets have been so low as to deter Japanese capitalists from investing in iron-mining and smelting on a large scale. There are only about half a dozen small iron smelting works in Japan.

Deposits of chromic iron ore occur in four Provinces. All the known deposits are worked in a small way and yield about 2,000 tons of ore yearly.

Antimony, Manganese, and Tin.

These metals are mined with more or less success in several localities. Manganese ores are widely distributed in Japan. Deposits are recorded as having been found in 47 Provinces in Honshu, Shiku and Kyushu, and in two Provinces in Hokkaido. About 2,000 tons of manganese ore are mined annually. The bulk of this ore comes from mines in the Provinces of Shiribeshi, Mutsu, and Tamba.

Antimony ore is mined in the Provinces of Iyo, Suwo, Hyuga and Yamato. The ore is stibnite occurring in Mesozoic formations. The annual production of antimony is about 1,000 tons.

Cassiterite occurs in the Provinces of Satsuma, Hyuga, Tajima, Mino, Hitachi and Osumi. The annual production of tin is only about 30 tons, as compared with from 800 to 1,000 tons imported. The Japanese tin deposits are small and it is probable that, like America and France, Japan must continue to depend upon foreign supplies.

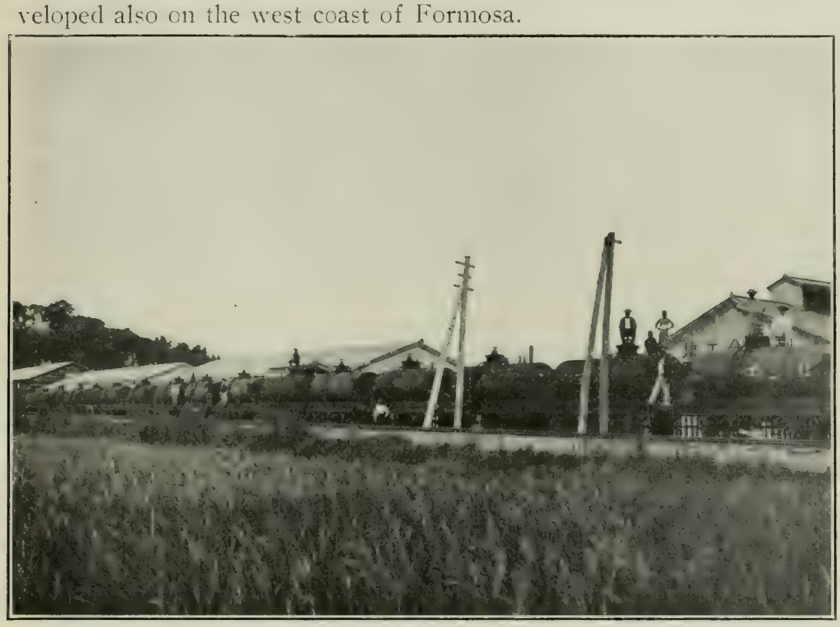
Sulphur.

Japan is situated on the line of volcanic activity that encircles the globe and, consequently, the country is frequently subjected to volcanic disturbances. The result is that the Islands contain numerous deposits of sulphur, mercury, lime, salt, petroleum and other mineral substances deposited by volcanic gases and waters.

Sulphur occupies the seventh position in rank of importance among the mineral products of Japan. About 40,000 tons of sulphur, valued at $500,000, are mined annually. Much of this sulphur is exported to China, Canada, the United States, Australia and other countries. It is mined in every part of the Empire from Formosa to Saghalien. The production of the mines is limited simply by the demand.

Petroleum.

Japan is fortunate in possessing numerous oilfields widely distributed. On the inner side of Northern Japan, starting at Kubiki, in the Province of Niigata, north of the city of Nagano, in the Island of Honshiu, west of Tokyo, a petroleum belt runs north through the Island of Hokkaido to Saghalien. Oil is found also in the Provinces of Mutsu, Ugo, Uzen, Echigo and Shinano. Oilfields are being developed also on the west coast of Formosa.

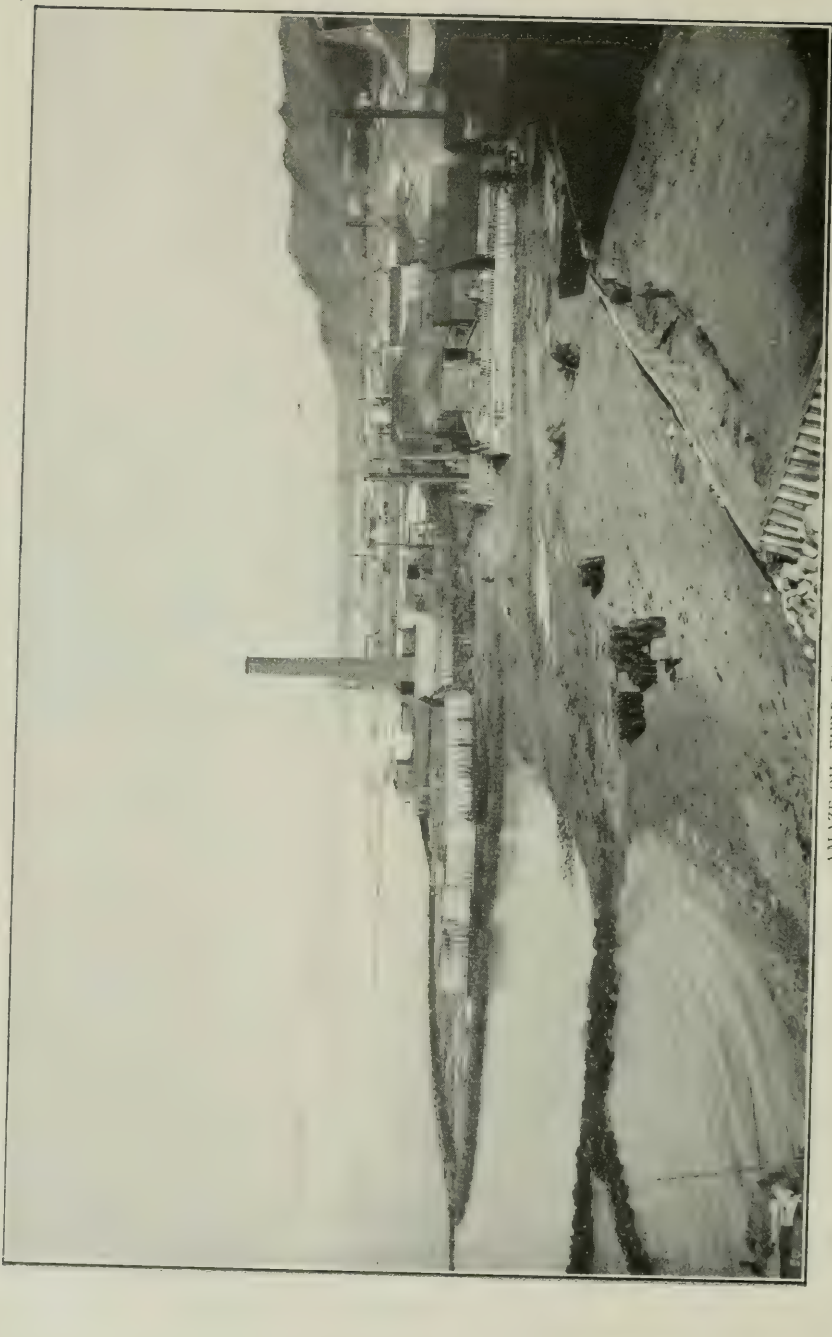


TANK-CAR DEPOT, JAPAN OIL CO., KASHIWAZAKI, ECHIGO.

The oilfields are chiefly monopolized by two large companies—the Japan and Hoden companies. The Nakano and Chuo companies are the principal oil producers after the two large companies. The Japan and Hoden companies produce 86 per cent of the annual output of petroleum, the Nakano and Chuo companies produce about 12 per cent, and numerous small companies produce the balance.

The oil is obtained from wells drilled to depths of from 600 to 3,000 feet by means of American rope drills. Ancient methods of drilling by bamboo poles are now being abandoned. About 2,000 of the producing wells were drilled by American methods, as compared with 300 by the Chinese and 250 by the Japanese methods.

Oil is carried from the wells to refineries by pipe lines. There are twelve important refineries now in operation. These are owned mainly by the Japan and Hoden companies. They produce about 40,000 barrels of benzine, 600,000 barrels of kerosene, 300,000 barrels of light-oil, 600,000 barrels of heavy-oil, 100,000 barrels of machinery oil and 2,000 tons of pitch and wax per annum.



AMAZE OIL FIELD, JAPAN OIL CO., ECHIGO.

The percentage of the petroleum products refined by the Hoden Oil Company is as follows: Kerosene, 43 per cent; heavy oil, 31 per cent; benzine, 7 per cent; pitch and wax, 7 per cent; light oil, 4 to 5 per cent; loss, 5 to 6 per cent.

The petroleum production of Japan in recent years is given in Table III.

TABLE III. PETROLEUM PRODUCTION 1900-8.

Year.	U. S. Barrels.	Year.	U. S. Barrels.
1900	871,740	1905	1,352,574
1901	1,117,995	1906	1,571,367
1902	997,543	1907	1,727,298
1903	1,210,340	1908	1,872,592
1904	1,220,744		

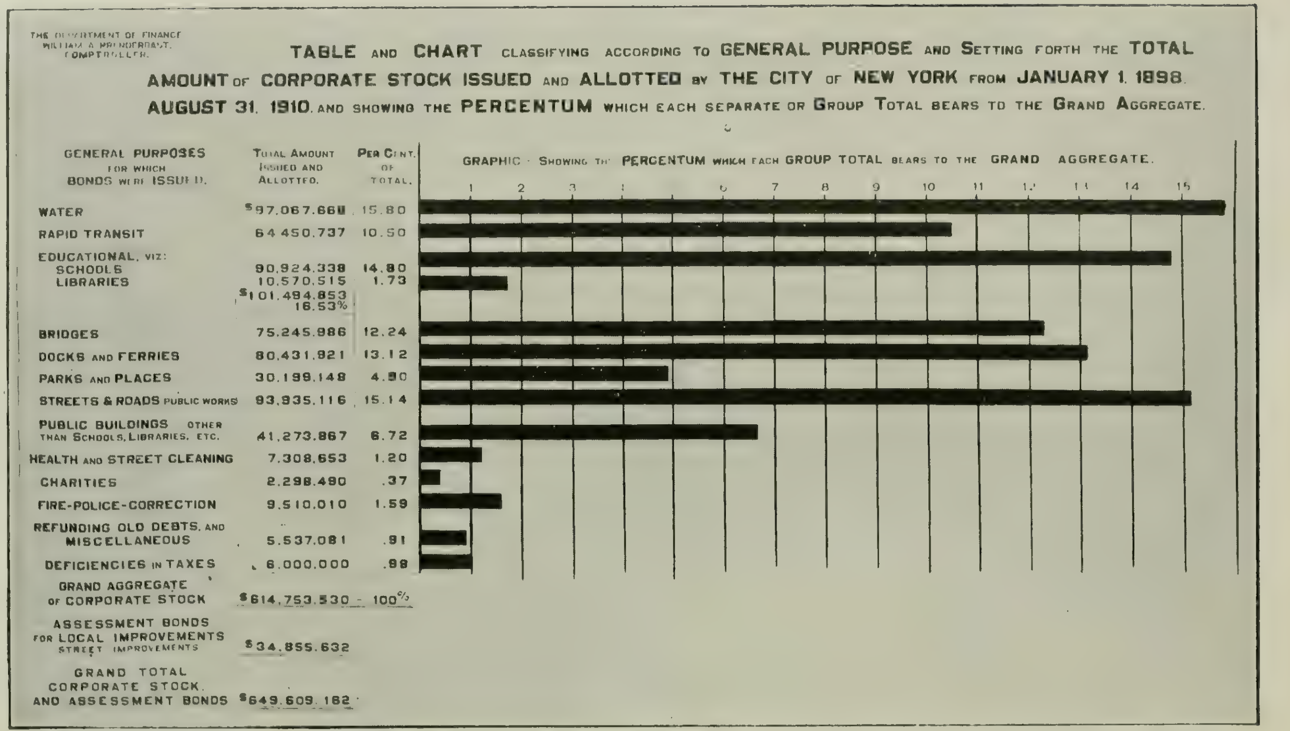
The bulk of the oil is at present obtained from oilfields in the Province of Echigo.

CONCLUSION.

The principal mineral resources of Japan have now been briefly reviewed in this and a previous article. But the list of minerals mined is not exhausted. There are deposits of asphalt, amber, abrasive materials, asbestos, gypsum, steatite, mica, quartz, fluorspar, phosphates, graphite, arsenic, sapphires, topaz, beryl, tourmaline, opal, agate and other valuable mining products worked by miners in the various provinces.

It will be seen that, on the whole, Nature has been kind in endowing Japan with a variety of mineral resources. The Empire's coal, copper, petroleum, antimony, iron, sulphur, zinc, silver and manganese deposits will be sufficient for her requirements for many centuries. Tin, lead, and a few other metals must always be imported from foreign countries.

Japanese mines are generally well worked and equipped with machinery. Good and efficient metallurgical works exist for the treatment of metallic ores close to the mines. Japanese engineers have shown a good aptitude for mining and metallurgical work and they have been well backed up by local capitalists. There is every reason for the belief that the remarkable progress made in the development of the Empire's mineral resources during the past decade will be continued, and that this steady improvement will powerfully contribute to the working out of the national ideals of the Japanese people.



THE DEPARTMENT OF FINANCE
WILLIAM A. PRENDERGAST.
COMPTROLLER.

TABLE AND CHART CLASSIFYING ACCORDING TO GENERAL PURPOSE AND SETTING FORTH THE TOTAL AMOUNT OF CORPORATE STOCK ISSUED AND ALLOTTED BY THE CITY OF NEW YORK FROM JANUARY 1. 1898. AUGUST 31. 1910. AND SHOWING THE PERCENTUM WHICH EACH SEPARATE OR GROUP TOTAL BEARS TO THE GRAND AGGREGATE.

GENERAL PURPOSES FOR WHICH BONDS WERE ISSUED.	TOTAL AMOUNT ISSUED AND ALLOTTED.	PER CENT. OF TOTAL.
WATER	$97.067.668	15.80
RAPID TRANSIT	64.450.737	10.50
EDUCATIONAL, VIZ:		
SCHOOLS	90.924.338	14.80
LIBRARIES	10.570.515	1.73
	$101.484.853 16.53%	
BRIDGES	75.245.986	12.24
DOCKS AND FERRIES	80.431.821	13.12
PARKS AND PLACES	30.199.148	4.90
STREETS & ROADS PUBLIC WORKS	93.935.116	15.14
PUBLIC BUILDINGS OTHER THAN SCHOOLS, LIBRARIES, ETC.	41,273.867	6.72
HEALTH AND STREET CLEANING	7.308.653	1.20
CHARITIES	2.298.490	.37
FIRE-POLICE-CORRECTION	9.510.010	1.59
REFUNDING OLD DEBTS, AND MISCELLANEOUS	5.537.081	.91
DEFICIENCIES IN TAXES	6.000.000	.98
GRAND AGGREGATE OF CORPORATE STOCK	$614,753.530	100%
ASSESSMENT BONDS FOR LOCAL IMPROVEMENTS STREET IMPROVEMENTS	$34.855.632	
GRAND TOTAL CORPORATE STOCK. AND ASSESSMENT BONDS	$649.609.162	

GRAPHIC · SHOWING THE PERCENTUM WHICH EACH GROUP TOTAL BEARS TO THE GRAND AGGREGATE.
1
2
3
6
7
8
9
10
11
14
15

GRAPHIC REPRESENTATION OF CORPORATE-STOCK ISSUES, SHOWING THE LARGE PROPORTION DEVOTED TO ENGINEERING WORKS.

AN INFLUENCE FOR EFFICIENCY IN MUNICIPAL ADMINISTRATION.

By Herbert T. Wade.

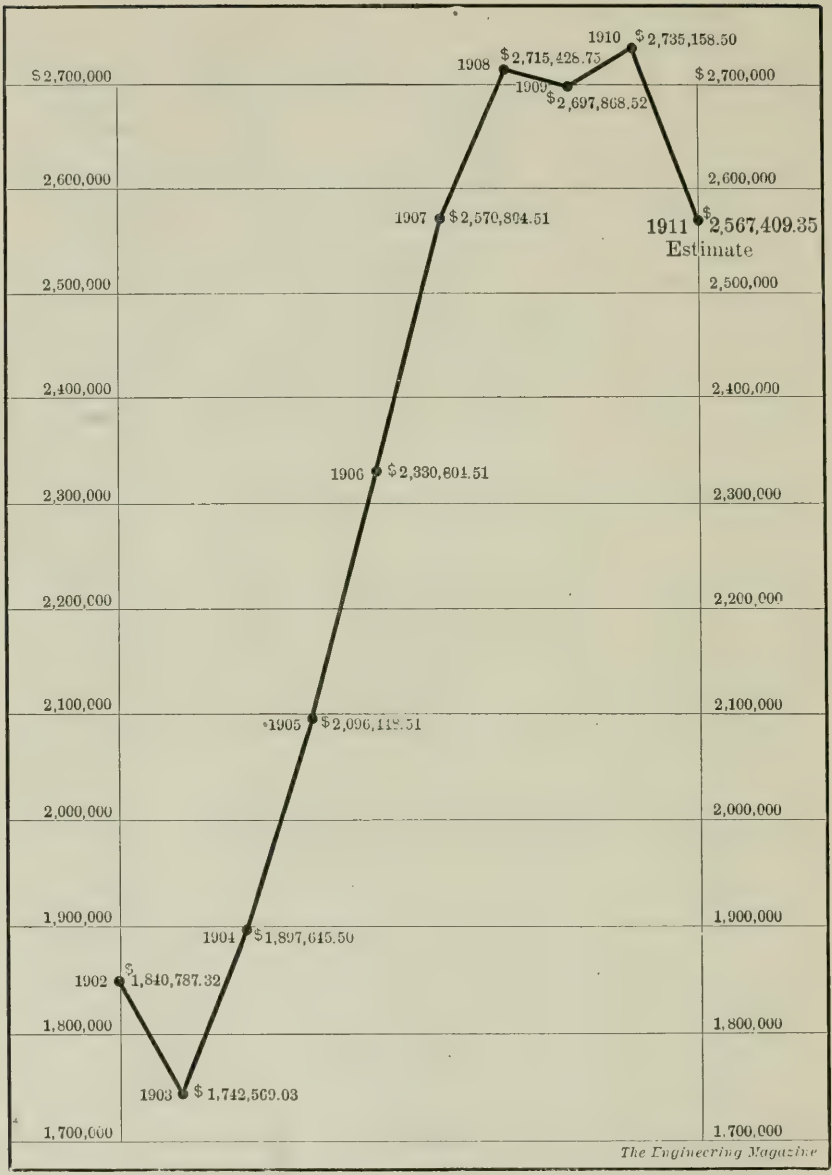
THE NEW YORK BUDGET EXHIBIT OF 1910.

We doubt that the predominance of purely engineering problems in the administration of a large city has ever been so convincingly shown as in the New York Budget Exhibit of 1910. The chart on the opposite page indicates that of the revenues from issues of corporate stock during the last thirteen years, over 70 per cent has been expended on permanent engineering works. Mr. Wade demonstrates in the following pages that the routine of city administration, involving no extraordinary construction or development, calls for engineering ability of a high order, and that the economy and efficiency of municipal government depend, to a large extent, on the placing of competent engineers in the positions of highest administrative authority.—THE EDITORS.

THE Charter of the City of New York provides that each October the Budget of the city's expenses for the following year shall be considered and passed upon by the Board of Estimate and Apportionment and the Board of Aldermen, which make appropriations therefor from the income derived from taxes and other sources. Every city department has the right to explain the purposes for which it desires appropriations, and on the other hand it must be prepared to explain and defend the requests it submits. Such discussions quite naturally involve some consideration of the economy and conduct of the particular department with special reference to values received for public monies expended.

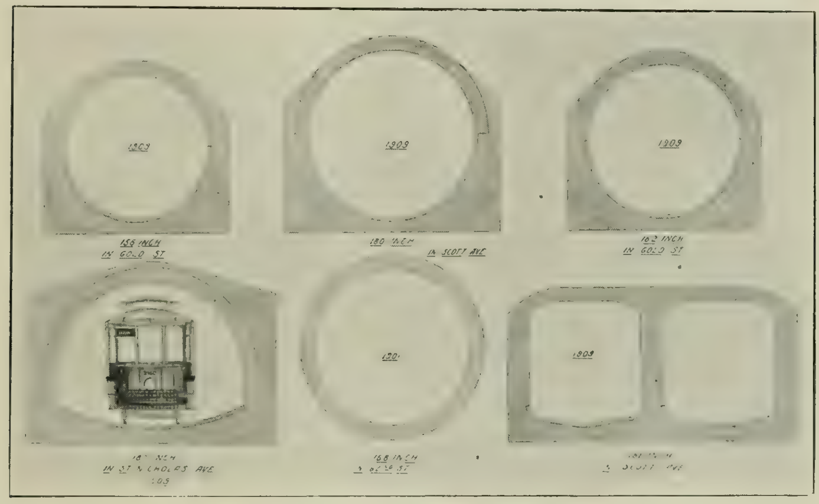
This is a matter that does not concern merely the Mayor and the administration, however keen they may be for a record for efficiency and progress. It is, or at least should be, of vital interest to every citizen, for here he is told the story of his taxes and of the efficiency of the government he has chosen. Therefore what information is supplied to the Mayor and his colleagues in the form of statistics and tables, should be no less useful to the citizen, if it can be put before him simply and in such manner as to stimulate his interest. Once general interest is aroused in this matter an important step towards better municipal administration has been accomplished.

This was the object and the function of such a popular exhibition as was held by the City of New York during the month of October in a vacant mercantile building on Broadway. This so-called "Budget Exhibit" was distinctly educational and attempted to supply the



BUDGET APPROPRIATION, BOROUGH PRESIDENT'S OFFICE, MANHATTAN, 1902-1911.

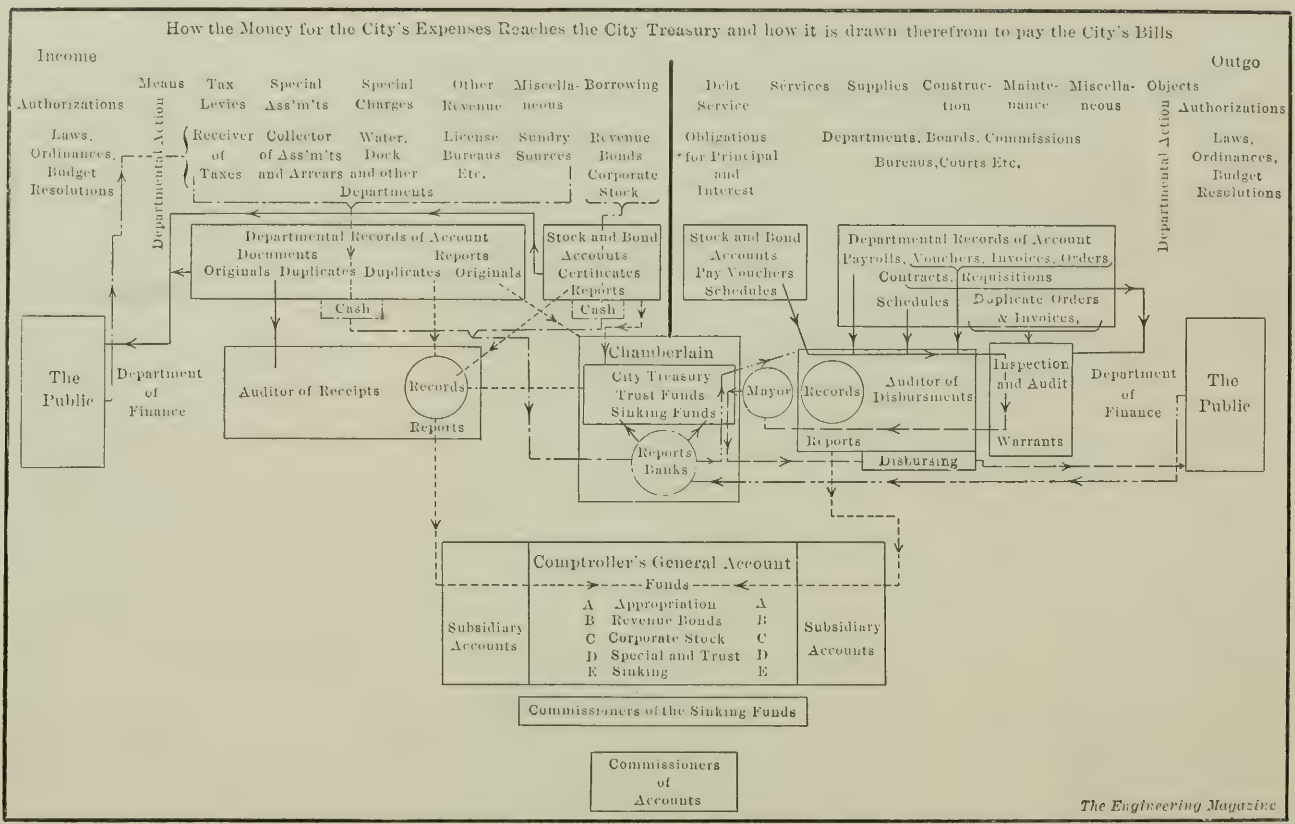
fullest information in answer to the question, what was being done with the taxpayers' money. Naturally and fittingly it was held at the time when the Budget for the year 1911 was being considered by the Board of Estimate. In fact, such an exhibition fundamentally was but an incident of this work, for all that was asked was that the various departments should show by charts, diagrams, pictorially or otherwise, to what uses the desired appropriations were to be put, the aim being to make the statements simple and easily understood. The Budget Exhibit was not intended, nor must it be considered, as a panacea for municipal maladministration or a direct corrective of inefficiency or corruption actual or alleged. It was a record, one might almost say a picture-book, of the activities of a great corporation in which every citizen should have a live interest, as with a greater or less number of these activities he comes into daily contact.



SOME OF THE LARGE SEWERS OF NEW YORK, A STANDARD TROLLEY CAR DRAWN TO SCALE FURNISHING A COMPARISON.

The inspiration for this exhibition came from attempts made in 1908 and 1909 by the Bureau of Municipal Research to present to the public by charts and diagrams some significant information in connection with the preparation of the annual budgets of those years. These simple displays were termed budget exhibits, and showed the importance of the work of the Bureau, a private agency maintained through the interest of public-spirited citizens to study and investigate matters dealing with municipal administration.

In this effort to arouse interest among the citizens of the great city in their municipal problems a critical attitude was assumed, and the expenses of the city were analyzed in connection with its growth, showing the disproportionate administrative cost to increase of popu-


How the Money for the City's Expenses Reaches the City Treasury and how it is drawn therefrom to pay the City's Bills

The Engineering Magazine

THE CHANNELS OF THE CITY'S INCOME AND OUTGO.

THE TWO GREAT SOURCES FROM WHICH BUDGET EXPENDITURES ARE PROVIDED

TABLE AND GRAPHIC SHOWING THE TOTAL AMOUNT OF REVENUES PROVIDED BY CURRENT TAX LEVIES AND FROM GENERAL FUND RESPECTIVELY TO MEET THE ANNUAL BUDGET APPROPRIATIONS FROM 1900–1910 AND VARYING YEARLY PER CENTUMS THEREOF

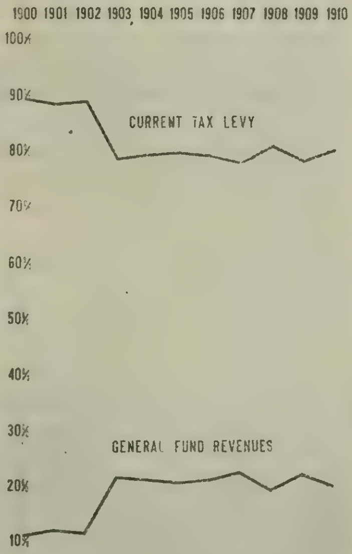
YEAR	BUDGET A	REVENUES TO MEET BUDGET: TAXES A	REVENUES TO MEET BUDGET: GENERAL FUND B	TAX LEVY PER CENT	GENERAL FUND PER CENT
1900	$90,778,972.48	80,923,699.77	9,855,272.71	89.14	10.86
1901	98,100,413.43	86,312,463.55	11,787,949.88	87.98	12.02
1902	98,619,600.88	87,222,889.21	11,396,711.67	88.44	11.56
1903	97,119,031.10	76,110,454.87	21,008,576.23	78.36	21.63
1904	106,674,955.09	84,383,361.07	22,291,594.02	79.10	20.90
1905	109,817,593.03	87,240,829.19	22,576,763.84	79.44	20.56
1906	116,805,490.37	92,253,085.71	24,552,404.66	78.98	21.02
1907	127,421,505.66	98,950,253.58	28,471,252.08	77.66	22.34
1908	140,572,266.17	113,542,896.09	27,029,370.08	80.77	19.23
1909	153,622,701.06	119,822,763.09	33,807,537.97	78.00	22.00
1910	159,128,270.37	127,478,283.11	31,649,987.26	80.17	19.89

NOTE— [illegible]

A [illegible]

B [illegible]

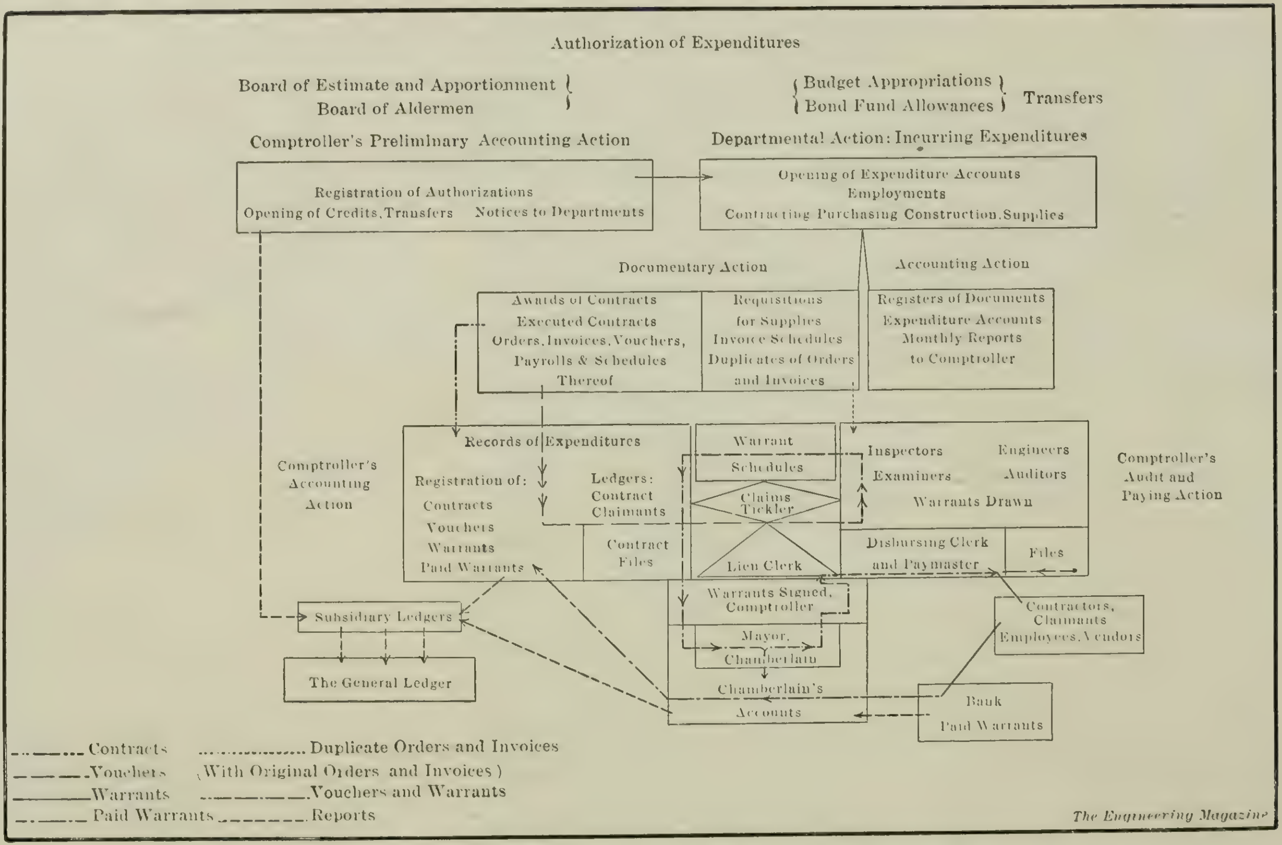
COMPARISON OF THE VARYING YEARLY PER CENTUMS OF THE TAX LEVY AND OF THE GENERAL FUND REVENUES TO THE TOTAL YEARLY REVENUE REQUIRED FOR BUDGET APPROPRIATIONS.



A STUDY IN REVENUE AND TAXATION.

lation. Instances were shown where supplies and equipment were purchased by the city and contracts executed at much higher expense or on terms less favorable to the city than would prevail in the case of individuals or private corporations. Good results were accomplished both in arousing public interest in municipal economics and in compelling from the heads of the departments a closer analysis of previous appropriations and of the items in their requests for additional appropriations. As a result for 1910 there was secured a more scientific and businesslike budget, the various departments being called upon to analyze and specify their requests and statements in a manner never before attempted.

The more attention the matter received the more general appreciation there was of the good effects of this publicity and education, and accordingly it was decided by the City authorities to arrange



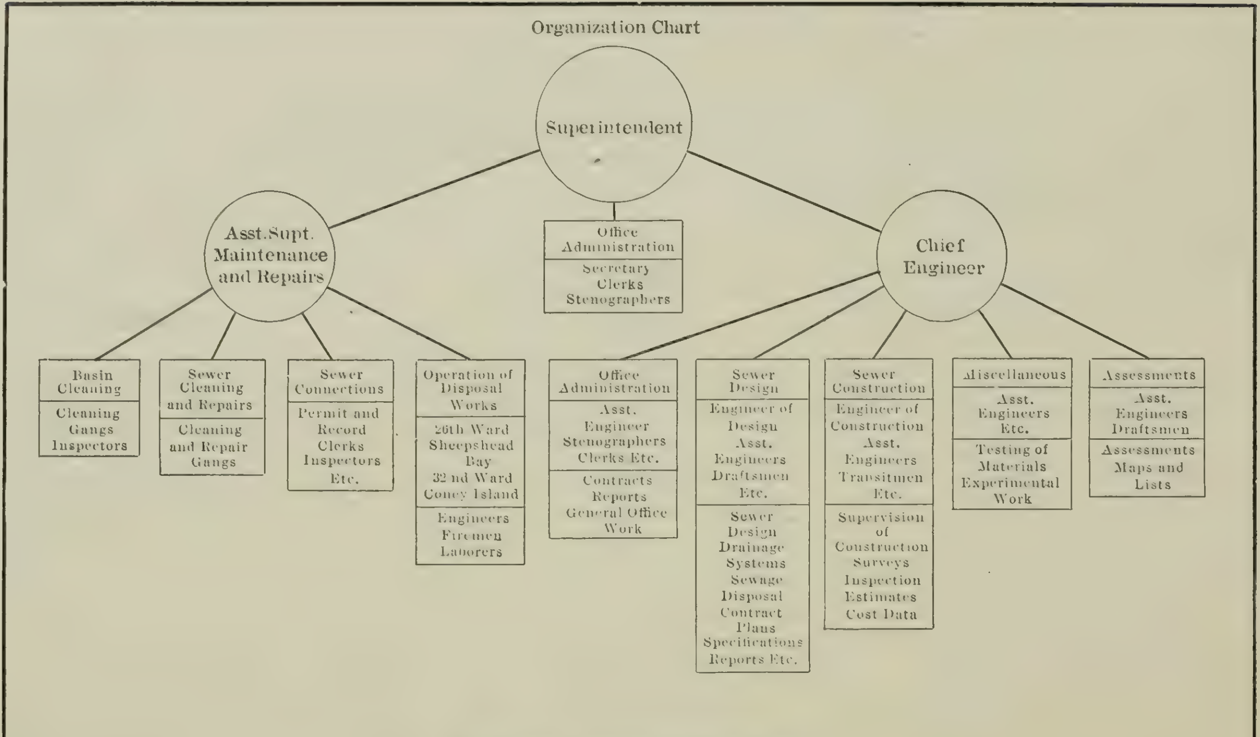
The Engineering Magazine

THE CITY HALL OF NEW YORK. MECHANISM OF MUNICIPAL EXPENDITURE AND ITS CONTROL.

such an exhibit in connection with the 1911 budget and to extend its scope. The city departments were informed that they could add to their exhibits prepared for the budget proper, physical objects such as apparatus and equipment, photographs and other material that would afford an interesting illustration of work in the various fields of municipal activity. With no attempt at uniformity or standardization, and in the great majority of cases without the slightest previous experience in arranging objects for exhibition purposes, there was naturally wide diversity of method and this added to the interest of the spectator. Thus in some departments the exhibits were essential spectacular and of direct popular appeal, as the prize-winning and notable horses of the Street Cleaning and Fire Departments stabled in the basement along with the most modern apparatus of these departments. In other cases the statistical charts and diagrams were supplemented by complete collections of photographs, while in others actual work of testing was in progress. Especially interesting were the exhibits of those departments where objects of historical importance or illustrative of types were shown.

The exhibition, all things considered, was unique and entitled to very serious consideration, both for its immediate and educational value and for the many possibilities it suggested. It demonstrated the important part that systematic and organized economy should play in municipal administration, and emphasized to the general public to what a predominant extent engineering works figure in a great city. In fact, this was indicated so plainly that the conclusion was irresistible that our municipalities today must use in greater numbers the services of engineers and technical men in administrative positions of high authority, not restricting them to subordinate and advisory duties. Indeed, it was pointed out that just as the great railways are using men drawn from their operating and maintenance departments as presidents and vice-presidents and managers, so it will not be long before municipal works must be in the hands of engineers if the highest efficiency and economy are to be secured.

The Budget Exhibit afforded sufficient data to enable one to study the efficiency of the great municipal corporation as a whole and in some detail for a number of the various departments. Thus its work could be compared with that of a private corporation, and in addition one could learn what steps were being taken to provide the additional utilities and facilities needed in the course of future growth and development, or in other words to secure adequate plant and equipment to take care of present and future demands.

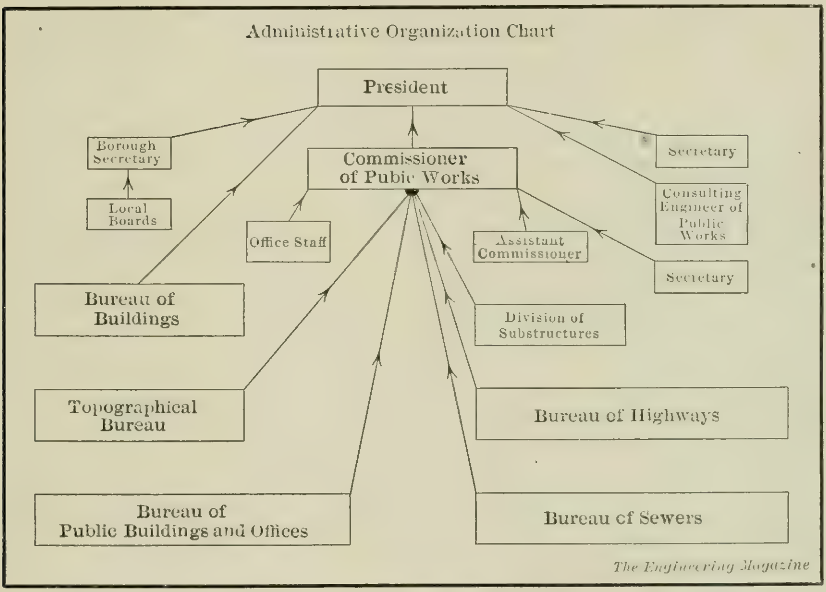

Organization Chart
Superintendent
Asst. Supt. Maintenance and Repairs
Office Administration
Secretary
Clerks
Stenographers
Chief Engineer
Basin Cleaning
Cleaning Gangs Inspectors
Sewer Cleaning and Repairs
Cleaning and Repair Gangs
Sewer Connections
Permit and Record Clerks Inspectors Etc.
Operation of Disposal Works
26th Ward Sheepshead Bay
32 nd Ward Coney Island
Engineers Firemen Laborers
Office Administration
Asst. Engineer Stenographers Clerks Etc.
Contracts Reports General Office Work
Sewer Design
Engineer of Design Asst. Engineers Draftsmen Etc.
Sewer Design Drainage Systems Sewage Disposal Contract Plans Specifications Reports Etc.
Sewer Construction
Engineer of Construction Asst. Engineers Transitmen Etc.
Supervision of Construction Surveys Inspection Estimates Cost Data
Miscellaneous
Asst. Engineers Etc.
Testing of Materials Experimental Work
Assessments
Asst. Engineers Draftsmen
Assessments Maps and Lists

1910 Budget Appropriation $538,159.39
1911 Budget Estimate $473,576.10

The Engineering Magazine

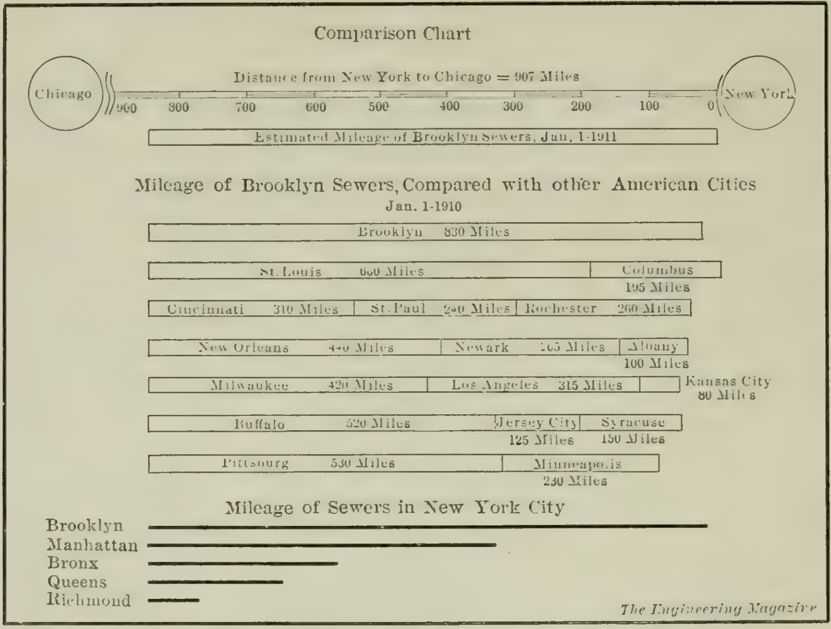
ORGANIZATION CHART OF THE BUREAU OF SEWERS, BROOKLYN.

Any study of municipal efficiency must begin with the organization of the City Government and this was made plain in considerable detail and for all its various branches at the Exhibit by means of graphic charts, a few of which are here reproduced. This city organization is provided for by the Charter, and for better or worse represents the system according to which the City business must be transacted. This of course imposes considerable permanence upon the organization, which unlike a private corporation can not be changed without the amendment of the Charter. So that the first lesson to be learned from the exhibition is the interrelation of the various departments and the accountability of officials and subordinate bureaus, with the precise functions and methods of the latter.



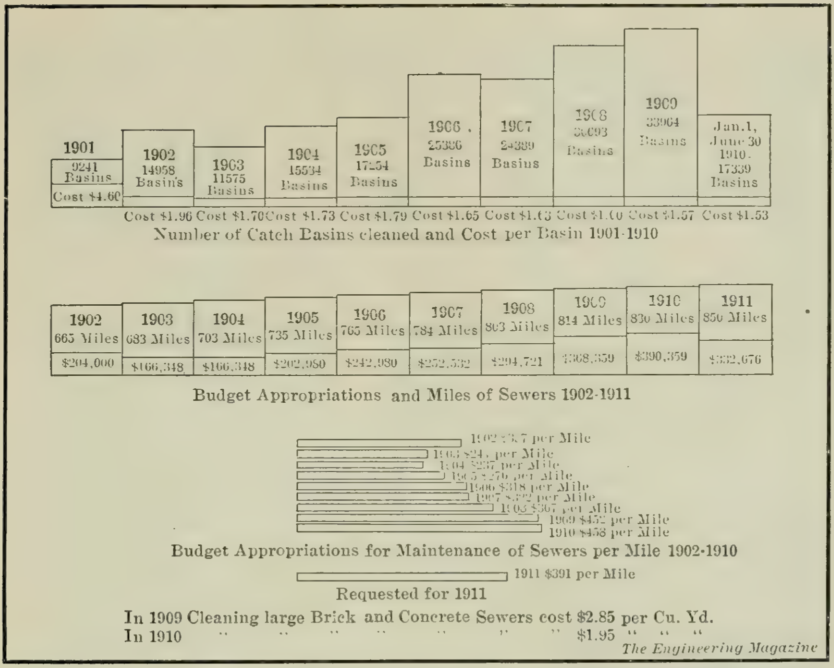
ADMINISTRATIVE ORGANIZATION CHART, BROOKLYN BOROUGH PRESIDENT.

After organization comes the question of resources, or the means to provide for the City's working capital and current expenses. The bonded indebtedness of the City should represent the money expended for permanent improvements which have an earning or perpetual value to the city, as the docks and water supply and the schools, parks and streets. These issues are now known as "corporate stock" and sound city finance demands that such bonds never should be issued for mere maintenance or current expenses, though occasionally this may be unavoidable.



COMPARISON CHART SHOWING MILEAGE OF BROOKLYN SEWERS.

The sources of the City's income are taxes and special accounts such as liquor excise, mortgage and bank taxes, and rentals and payments for franchises, and from this income the appropriations of the Budget are made. The money comes from the public and is expended for the public as was shown graphically on the chart reproduced herewith. It is of course obvious that the taxes in amount must depend upon the amount of the Budget and the tax rate on the assessed valuation. This of course brings up the machinery of assessment and relative valuations which were duly explained by maps and charts. With money thus provided the conduct of the financial side of the City's business and the supervision of its appropriations and expenses falls to the Comptroller and his associates in the Department of Finance. The mechanism and municipal expenditures is arranged as provided by the Charter and by modern methods of accounting, which now are being greatly improved in their application to municipal conditions. As we have seen the large extent to which engineering operations figure in the City's business it can be readily understood that the Finance Department and the Board of Estimate and Apportionment must maintain their engineering staffs. In the former, investigations must be made of the work done by con-



Number of Catch Basins cleaned and Cost per Basin 1901-1910

Budget Appropriations and Miles of Sewers 1902-1911

Budget Appropriations for Maintenance of Sewers per Mile 1902-1910

Requested for 1911

In 1909 Cleaning large Brick and Concrete Sewers cost $2.85 per Cu. Yd.
In 1910 " " " " " " " $1.95 " " "

The Engineering Magazine

BROOKLYN BUREAU OF SEWERS, MILEAGE AND BUDGET APPROPRIATIONS, 1902-1911.

tractors, and the contracts themselves must be considered in view of engineering questions before they are executed by the representatives of the City. And equally important is the consideration to be given to any proposal for a public franchise by the Board of Estimate, and here the economic side of engineering work is illustrated. Both of these features were brought out prominently by charts in the exhibits of the departments concerned and also the results and expense of such engineering work in some detail.

In almost every department the organization was shown most effectively and it is of course impossible to trace this interesting matter for all of the many branches of the City's activity. A few sample charts will show the methods followed, the aim being to give with the organization the appropriations allotted to the various subdivisions. The charts showing the organization of the office of the Borough President of Brooklyn are reproduced herewith and it will be noted that with the requests for appropriations for 1911 are given those for 1910, amplified in many cases with some record of the work actually accomplished under such appropriations. The work of each of the bureaus of this office is then taken up in greater detail, show-

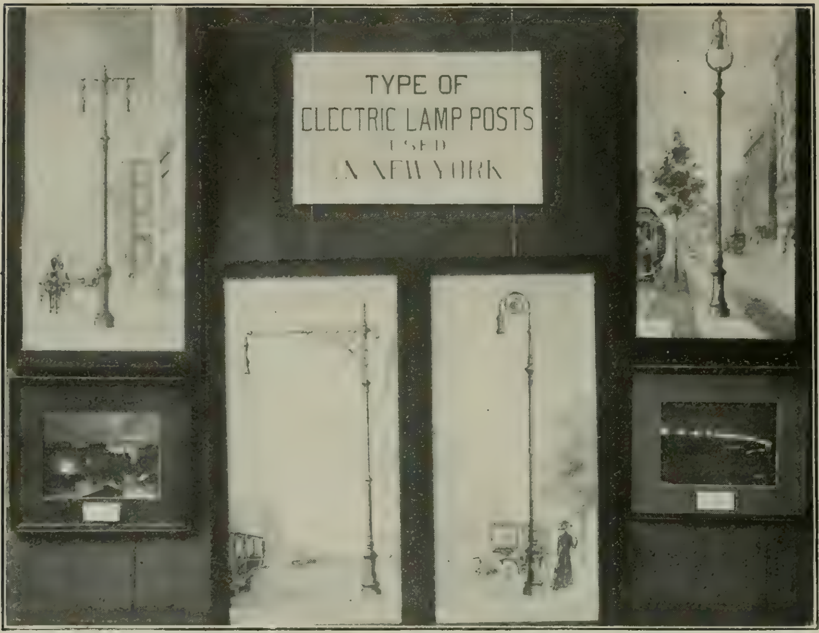
A CORNER IN THE HOSPITAL EXHIBIT.

ing the number of officials and other employees, the amount of work accomplished, and the extent of territory under its care. Then to supplement this were many photographs showing plant and methods as well as the actual performance of the work, while such objects as street signs were also exhibited. In such exhibits the most interesting features were the progress diagrams showing the advance of the city's work in paving, sewer construction, building of baths and markets or similar acitvities. In many cases, and plainly desirable in all, comparative figures were given and the work figured down to a unit cost basis. This appears in the accompanying diagrams of the Bureau of Sewers of the Borough of Brooklyn, and they are both illustrative and typical of many of the different bureaus of the various boroughs or of the city departments.

It was remarked at the exhibition that in subsequent presentations of departmental activities unit costs would figure to a larger extent and would supply valuable data for studies of comparative municipal efficiency, especially as a number of other American cities are contemplating taking up the idea of the budget exhibit and holding similar municipal exhibitions. This was suggested in some of the charts where comparisons were made between the work of some of the single boroughs of New York and other smaller American cities.

An analysis of the various exhibits would mean an analysis of the engineering and maintenance work of the city, a field as fertile when discussed comprehensively as it has been productive in the past along critical lines. While there has been often a wide discrepancy between the design of municipal engineering projects and the economy of their execution, yet steady progress is being made and higher standards of administrative efficiency are shown.

In municipal economy a great defect and often alleged opportunity for corruption has been the purchase of supplies and equipment. Therefore interest attached to reforms in methods of purchasing shown by several of the departments where competitive bids were asked for or other improved methods adopted. Thus the Fire Department exhibited a large number of objects illustrating everyday supplies as well as fire equipment, to each of which was attached a tag stating the price paid, with further explanation in case of a patented article. Prices and qualities were available for inspection by the taxpayer or dealer, so that any criticism of the purchasing bureau could be made if just cause existed. Furthermore the Fire Department made an exhibit of the work of its repair shops, recently reorganized on an efficiency and cost-accounting basis with a considerable

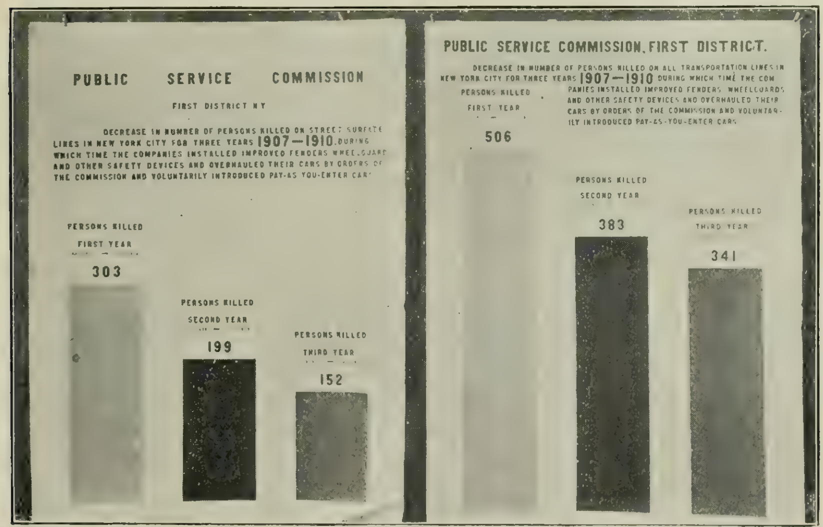


EFFORTS IN MUNICIPAL ESTHETICS.

annual saving to the City and an increase of over 30 per cent in the output, with a reduction of the force from 169 to 150. In 1910 the Bureau of Repairs and Supplies, in which the repair shops are included, while working under an appropriation $81,817 less than for 1909, was able to save $135,000 from the $912,898 appropriated for this purpose.

Here were shown various supplies manufactured in the shops and to each object was attached a cost ticket for the information of any one interested. That there was interest was shown by criticism made of the high cost of a small job from the carpenter's shop. The charge, apparently well founded, led to an investigation and for a small object selected almost at random it was found possible to place the responsibility of its high cost as the various elements of the job were accounted for from the cost record. The explanation was in the labor, which was that of a slow and inefficient workman, protected in his position by Civil-Service rules. This is typical of the tendency towards stricter accountability that is being manifested in most of the city departments and would have been unheard of a quarter of a century ago. But it is exactly such work as is necessary, for from the very nature of their business city shops and bureaus do not lend themselves readily to efficient operation, concerned usually as they are with emergency work and general repairs rather than manufacturing. It is for that reason that the growth of cost accounting in the municipal machine is as desirable as it is necessary, and successive budget exhibits doubtless will show great progress in this field.

If there is saving for the City in its ordinary work by applying business methods, what can be said of those extraordinary expenditures for well considered improvements that produce an immediate and direct return on the investment. Thus among the lessons to be learned from observing a historical exhibit of fire apparatus culminating with modern automobile machinery was that a year's trial had demonstrated that a motor hose wagon could be maintained at practically the cost of shoeing one of the three horses required for a similar horse-drawn vehicle, and could give better service, so that the citizens were prepared for the announcement that New York was gradually putting its Fire Department on a motor basis. Again as fire houses require no individuality of arrangement or construction, why should there be different plans for each. Accordingly there were shown models of standard type reinforced concrete fire houses for which plans had been evolved and which would be repeated as demanded. Again the high-pressure fire service has eliminated fire engines from the district thus protected, with obvious economy in maintenance, and has caused an important reduction of insurance rates for property in this territory.



DECREASE IN NUMBER OF PERSONS KILLED ON STREET SURFACE LINES IN NEW YORK CITY FOR THREE YEARS 1907—1910. DURING WHICH TIME THE COMPANIES INSTALLED IMPROVED FENDERS WHEEL GUARDS AND OTHER SAFETY DEVICES AND OVERHAULED THEIR CARS BY ORDERS OF THE COMMISSION AND VOLUNTARILY INTRODUCED PAY-AS YOU-ENTER CARS

DECREASE IN NUMBER OF PERSONS KILLED ON ALL TRANSPORTATION LINES IN NEW YORK CITY FOR THREE YEARS 1907—1910 DURING WHICH TIME THE COMPANIES INSTALLED IMPROVED FENDERS WHEELGUARDS AND OTHER SAFETY DEVICES AND OVERHAULED THEIR CARS BY ORDERS OF THE COMMISSION AND VOLUNTARILY INTRODUCED PAY-AS-YOU-ENTER CARS

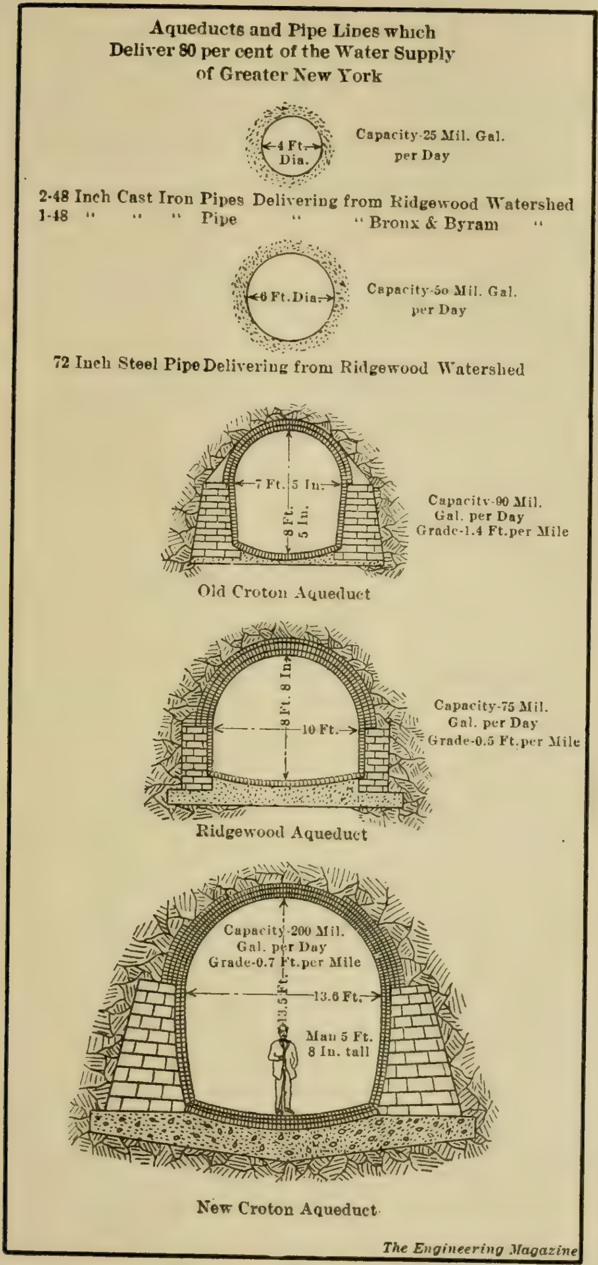
DECREASE IN FATAL STREET-CAR ACCIDENTS FOLLOWING THE USE OF SAFETY DEVICES, ETC.

So much is being done to increase the water supply of New York, more especially the new Catskill Aqueduct in course of construction, involving as it does an estimated outlay of some $160,000,000, that it was but natural that some idea should be given to the citizens of this enormous project. Accordingly there were exhibited models of the important dams, plans and progress diagrams for the tunnels and other works, and numerous photographs to show how this great undertaking is advancing and the conditions under which it is being accomplished. A full sized model showed the cross section of the great aqueduct and typical cross sections of other aqueducts shown in comparison gave some idea of the immensity of an undertaking that can almost rival the construction of the Panama Canal.

If the work of the Water Board involves the source and provision of the water supply of the second city of the world, that of the Department of Water Supply, Gas and Electricity is concerned with its distribution, and the historical objects and charts were striking lessons in the growth of the City. From the wooden pump logs of Aaron Burr's Manhattan Company to the modern high-pressure steel main is indeed a transition, but it was merely typical of other progress. Thus there was represented a fire hydrant, of a type of which many are to be found in the city, so inadequate as to be incapable of supplying a first-size steam fire engine, as contrasted with modern hydrants now being installed on the high-pressure mains with a capacity of three or four steamers. There was also shown the method and apparatus for tapping mains with a minimum waste of water in making a connection with the service pipe of a building, and the methods of metering and detecting leaks. An impressive object lesson was the expense of a leaky faucet as shown by a meter in operation.

Familiar as is the fact to engineers, yet few of the citizens of New York realize that four of the largest bridges in the world connect Manhattan with Long Island and that they exert a most important bearing on the present life and future development of the city apart from any consideration of the engineering elements involved in their construction and maintenance. Today when the subaqueous tunnel figures so prominently in schemes of urban and suburban rapid transit where rivers or tidal water are concerned, the efficiency of the bridge and the traffic it can carry are matters of peculiar interest. It is only fair for the citizen to consider the traffic carried by the bridges, note its diversity, and then figure on the economy.

Furthermore in New York the Bridge Department somewhat anomalously is engaged in building one of the largest and tallest office

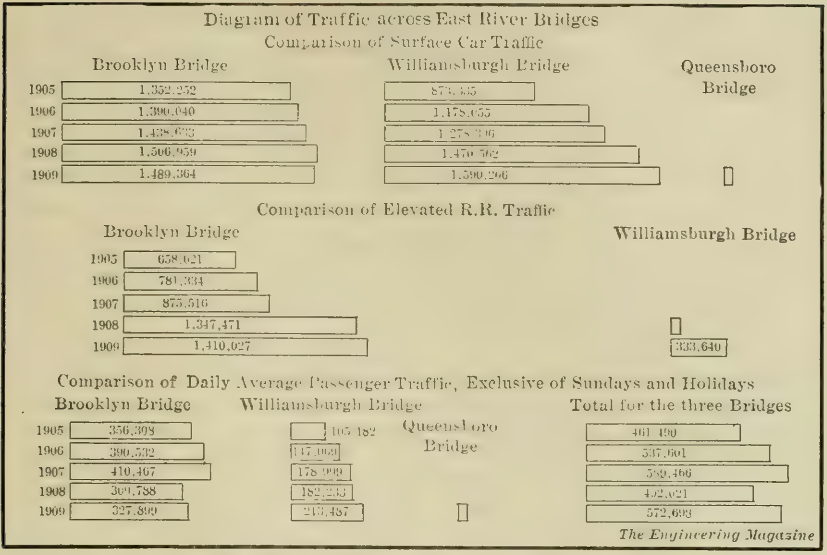

Aqueducts and Pipe Lines which Deliver 80 per cent of the Water Supply of Greater New York
4 Ft. Dia.
Capacity-25 Mil. Gal. per Day
2-48 Inch Cast Iron Pipes Delivering from Ridgewood Watershed
1-48 " " " Pipe " " Bronx & Byram "
6 Ft. Dia.
Capacity-50 Mil. Gal. per Day
72 Inch Steel Pipe Delivering from Ridgewood Watershed
7 Ft. 5 In.
8 Ft. 5 In.
Capacity-90 Mil. Gal. per Day Grade-1.4 Ft. per Mile
Old Croton Aqueduct
8 Ft. 8 In.
10 Ft.
Capacity-75 Mil. Gal. per Day Grade-0.5 Ft. per Mile
Ridgewood Aqueduct
Capacity-200 Mil. Gal. per Day Grade-0.7 Ft. per Mile
13.6 Ft.
13.5 Ft.
Man 5 Ft. 8 In. tall
New Croton Aqueduct
The Engineering Magazine

AQUEDUCTS AND PIPE LINES DELIVERING 80 PER CENT OF THE WATER SUPPLY OF GREATER NEW YORK.

buildings in the City to house many of the City offices as well as provide a terminal for the subway trains crossing to Brooklyn. Here is a very simple example of municipal finance. The terminal is demanded, so the ground must be secured. Therefore it is possible by an outlay of $11,100,000 to build an office building large enough to house many of the departments for which offices are being rented in private buildings at an annual expense estimated at over $600,000. As the interest on the bonds issued for the erection of such a building would amount only to about $450,000, the saving to the City both in money and convenience is most apparent, while the erection of a fine monumental structure serves to beautify the official centre of the City.

In practically every department of the City the work of the engineer and architect is encountered at least in providing the necessary buildings and plant, even if their services are not demanded for the operation. This is shown in the departments of Education, Health, and the various corrective and charitable institutions, of which Bellevue and Allied Hospitals may be taken as typical for the interesting exhibit that they made of their work and equipment, accompanied by requests for additional appropriations in order to extend it further. Such exhibits assembled together brought directly to public attention what previously has not always been realized, that municipal betterments, necessary as they may seem to the philanthropist and the specially interested reformer, can not be executed without expense, and that each problem, while it may appear to such persons most vital, is but one phase of a larger one. In the case of hospitals, schools, reform and penal institutions, parks, etc., it is of course plain that with better equipment and increased facilities and plant far better and more valuable work could be done, but such appropriations would at once react on the tax-rate, increasing rents and living expenses so that the advantage might be questionable in many cases and negative in not a few. Therefore the present problem for city administrative officers is to secure under present conditions maximum efficiency and economy and see that the various institutions are brought up to their fullest possibilities, making of course due and judicious provision for the future. These considerations were emphasized at the Budget Exhibit by the splendid exhibits made by all of these institutions.

Wherever it was possible to show anything in action from a census tabulating machine to a fire alarm the opportunity was seized upon, and the citizen of New York for once at least had the opportunity to become conversant with the City government and its operation. Every department was represented and in addition to exhibits lectures were given daily in a small auditorium by representative officials, while a series of booklets describing the duties of the various bureaus and departments was prepared and distributed to supplement the exhibition proper. In fact, so much interest was aroused that in many quarters was heard a demand for a permanent municipal museum as a record of the City's history and activity on its administrative and material side. The large attendance demonstrated that civic interest and pride were more than latent and that there was a genuine desire to learn about the resources and methods of the city government.



The Engineering Magazine

DIAGRAM OF TRAFFIC ACROSS THE EAST RIVER BRIDGES.

As a picture of the city's condition and activity it was strong, direct and forcible, and so obvious were its benefits and merits that there was included in the Budget for 1911 $25,000 appropriation for a similar exhibition in connection with the Budget for 1912. In future exhibits it should be possible to secure such a standardization of presentation that the main facts in the City's economy could be presented from year to year systematically and an intelligent basis of comparison between different administrations as regards their efficiency could be made. This would put the matter still further outside of any spirit of mere partisan criticism and enable it to be considered as a business or efficiency proposition. In fact, with the political or at best semi-political government of American cities, partisan criticism has accomplished little save temporary improvement of conditions, and not always that. Lack of appreciation of efficiency and honesty in effort and achievement has been all too common in municipal work and is responsible for many of our present ills. But give the citizen with his growing interest in municipal efficiency the facts simply and succinctly stated and he will decide and decide rightly for good government. No administration or municipal party could afford to go before the voters for endorsement if its mayor or commissioners or other officials were shown to be less efficient than their predecessors.

That such progress would be increased by a permanent museum of municipal government seems evident, and a permanent record of the growth and development of the City would be of untold value. Such a museum would not only be replete with historic interest but would readily become a museum of standards where public exhibition could be made of the standard articles used by the City in its various departments, the exact specifications for their purchase and the method of test. This would be especially desirable in the event of the establishment of a central purchasing bureau for the entire city, but in any event it would permit public inspection and criticism of standards and prices so that at any time a superior article or one more economical could be brought to the attention of the city officials.

The history of a municipality unlike that of a state or nation is told largely by its monuments of stone and mortar, by its structures of iron and steel, made by its engineers and architects rather than by the lives of its soldiers and statesmen. The individuality of the authors of these massive works too often is sunk, but the works themselves remain as monuments of efficiency of government and sound engineering. For they are only possible where the money of the taxpayer is well conserved and wisely expended, and must be constructed in permanent and useful form productive of direct returns to the city. Politics and administrations may vary but water supply and facilities for commerce and the general well-being of the citizens are always needed, and these must progress according to some definite and prearranged plan. Now if the administration of justice, the preservation of the public peace, the alleviation of sickness and poverty, the prevention of fire, the preservation of the public health is not done effectively, little remains either of spirit or resource to make possible the permanent improvements that reflect so much credit on a city and add to the wealth and happiness of its citizens. In city government the connection between the material and the ideal must be ever present and is not to be discouraged, for growth in one is only possible through development in the other. The Budget Exhibit teaches that what is accomplished or needed on the material side of the city can be done only by the observance of principles of economy and efficiency. Once educate the citizen as to the methods of the municipal housekeeping and he will be ever watchful to demand efficiency in order to secure the greatest benefits in his daily life. Even among those who have graduated from practical politics into municipal administration it is now admitted that a record for efficiency and economy must be considered a paramount consideration.

EDITORIAL COMMENT

Scientific Management.

THROUGH attention attracted by the recent rate hearings at Washington, efficiency has taken rank as a National issue. Or, rather, its importance to continuation and progress of national welfare has gained wider recognition. The truth—always vital—is no greater than before, but acknowledgment of the truth is fuller. The recent awakening among manufacturers is remarkable. Eventually, even if reluctantly, the railways must follow.

It is not surprising that in the minds of old-line managers the suggestion of a new viewpoint from which to consider the whole problem of production should cause bewilderment. It is not surprising that they should seize upon the one element that has a familiar sound—piece rates—and leap angrily to the utterly false conclusion that scientific management is "a kind of piece work." It is even less surprising that the editors of daily and general periodicals should stumble and blunder over the purpose and scope of efficiency effort, and should confound it with mere physical driving at a faster rate.

It is, however, astonishing and deplorable that an engineering journal, which claims to lead educated thought, should sum up the question as it affects the efficiency of railway operation in the following syllogism: (1) Efficiency methods can not be applied to household servants; (2) running a railway is like keeping house; (3) therefore, efficiency engineering, or scientific management, can not be applied to railway operation.

In point of fact, the principles of efficiency engineering can be, have been, and are, most successfully applied to the management of the household and its servants. As the major premiss of this curious argument is untrue, it is unnecessary to consider the dignity or accuracy of the minor premiss. The conclusion falls without further attack.

It may be of interest, however, to follow one step further the editorial of which this syllogism is the central thought, because this next step is characteristic of the ill-informed concept of efficiency above referred to. The editorial goes on to suppose that a country railway station agent could be taught by "efficiency experts" "to sell tickets with one hand, while he made out freight way bills with the other"; nevertheless, there would be no gain because "the railway must have a whole man at each station and could not get along with 5/16 or 27/32 of a man"; so, it concludes, "there is no place that we can see where any saving could result in the railway payroll."

The vision of this writer is limited apparently to perspiration as a measure of efficiency. And yet a little observation of the work of a country station agent would suggest various ways in which, by elimination of wastes, prevention of losses, the acceptance of a larger view as to his functions and as to efficiency in performing them, with expert suggestion how best to accomplish this result, the agent might be stimulated to the very great advantage of the operation of the road, without any ambidextrous gymnastics or any strain on his muscular system.

He could save minutes in the movement of passenger trains by having his baggage on the trucks close to where the baggage car would stop, his people on the platform near to the coach steps, and attention to other details of his passenger business. He could save hours for the local freight, to say nothing of the saving to consignees, by the arrangement of his freight house and attention to his outgoing shipments, his way bills and records. He could save days in the detention of freight cars on his siding, by a combination of diplomacy and hustle in handling local shippers; he could be a good or a bad business agent for his road, and exercise a material influence on its earnings, even at a noncompetitive point.

It is interesting to see that the editorial reaches the conclusion that "the great difficulty with railway operations at present is that the men in charge are so overburdened with routine matters that they have as a rule no time or energy to spare for new means or methods of saving over those which have been long in use." The very genius of efficiency engineering or scientific management is that it places functional betterments in the hands of a separate staff, leaving the line officials free for routine administration. It lightens the burdens of the operating men, instead of adding something more to them.

Educational or Administrative Efficiency?

A STUDY of the efficiency of education is professedly difficult, and Mr. Morris Llewellyn Cooke's report on academic and industrial efficiency, made to the Carnegie Foundation, is prefaced by a full acknowledgment of this difficulty. He recognizes clearly the difference between the work defined by the instructions given him, and a final estimate of either absolute or relative efficiency measured by intellectual and moral effect upon the university student. It is somewhat hasty, therefore, to leap, as many commentators do, to the conclusion that Mr. Cooke's studies are a complete demonstration of great inefficiency in American universities, with perhaps some slight lift above the prevailing low level in the case of Columbia and Toronto.

So far as the use of funds, buildings, equipment, and personnel go, the most casual inspection would demonstrate that, judged by common industrial standards, our universities are wastefully administered. But the real energy of a university is mental and spiritual, and spiritual force is not measurable in any terms recognized in Mr. Cooke's instructions. He was limited to "an estimate of the cost and of the output both in teaching and in research in the departments of physics" in eight institutions. Even adopting so mechanical a concept of university "output," efficiency is determined largely by the balance and co-ordination of many departments. The method of inspecting a "sample" department is utterly inadequate.

So far as concerns the observations possible to a careful and intelligent inspector, the obtaining of material statistics, and deductions based on the discriminating use of principles of industrial efficiency, Mr. Cooke's report is admirable. He formulates conclusions in terms of student hours, room hours per week, and other unit data, permitting both absolute and relative measures of work to be made on this basis. The conspicuous lack both in Mr. Cooke's conclusions and in Dr. Pritchett's instructions, is the lack of realization of, or attempt to estimate, a factor that formerly at least was considered one of the prime influences, if not the foremost influence in university work—the influence of character and personality of great men. Let us qualify this by hastening to add that Mr. Cooke does recognize most fully the importance of allowing the professor the largest opportunity to express his individuality and his personal influence, by relieving him of conflicting duties in the same way that a high-priced industrial officer would be relieved. Nevertheless, his relative estimates, in certain specific cases, reverse the order of precedence in which these certain universities would stand if measured by their known success or failure in enlisting and keeping great men. The most important factor in the greatness of a university is the most subtle.

REVIEW OF THE ENGINEERING PRESS.

"THE WORLD IS ITS FIELD"

HUMPHREY PUMPS AND COMPRESSORS.

A REVIEW OF A YEAR'S PROGRESS IN THE IMPROVEMENT OF OLD AND THE DEVELOPMENT OF NEW DESIGNS.

Herbert A. Humphrey—Manchester Association of Engineers.

IT is just a year since the first paper by Herbert A. Humphrey descriptive of his gas pump and its application to air compression was reviewed in these columns. Our review of this paper, which was read before the Institution of Mechanical Engineers, was limited to a consideration of the possibilities of the system in the compression of air and in power production, and was intended merely to supplement an account in THE ENGINEERING MAGAZINE for December, 1909, of the principles and design of the gas pump and the results of Prof. Unwin's tests on the original unit. During the year the system has been developed with unexpected rapidity and has shown a remarkable flexibility. Pumps of the suction-lift type have been designed without the objectionable change-over valves incorporated in the first models. A simple device has been produced for automatically maintaining constant volume of the explosive charge, in spite of variations in the level of the supply water. The space occupied by a pump of a given size has been reduced; the 1,000 horsepower unit now under construction in Germany will compare favorably as to space occupied with a tandem double-acting gas engine of the same power. In short, no case has been presented in which the system has not proved elastic enough to meet the conditions.

A detailed review of the year's developments has been given by Mr. Humphrey in a recent paper before the Manchester Association of Engineers, printed in *Engineering* for November 18, 1910. So far, Mr. Humphrey confesses, the solutions of some of the problems presented to him exist only in designs, but in view of the simplicity and reliability of the pumps so far tested, he has no doubt that the new proposals will mature into efficient and commercialy successful machines. It is the purpose of this brief abstract of his paper to review a few of the most striking of the new designs.

The Humphrey system may be briefly described as "a method of raising or forcing liquid, which consists in applying the energy of expansion of an ignited combustible mixture to one end of a column of liquid so as to propel the column along a discharge pipe, and to cause it to oscillate in the pipe under such conditions of energy of the moving liquid that everything necessary for preparing for the next ignition is performed during one or more oscillations, and wholly or partly owing to it or them." Figure 1 shows the pump in its simplest form. Water is to be raised from a supply tank *ST* to an elevated tank *ET*. *C* is the combustion chamber, *W* the water valve box with valves *V* opening inwards, and *D* the discharge pipe. *A* and *E* are, respectively, inlet and exhaust valves connected by a simple interlocking gear. The cycle of operations is as follows: A charge of gas and air compressed in the top of *C* with all the valves closed is fired by a sparking plug in the top casing. The pressure of the expanding gases sets the whole column of water in *D* in motion, and this water attains a momentum so great that it continues to flow after the pressure of the gases has been reduced to that of the atmosphere. At this point the exhaust valve *E* opens by its own weight, and water is admitted through the valves *V*, mostly to follow the moving column in *D*, but partly to rise in chamber *C* in an effort to reach the level of the water surface in *ST*. When the water column has expended its kinetic energy, it flows back towards the pump, gaining velocity until it reaches the exhaust valve *E*, which it closes by impact. The energy of the moving column is expended in compressing the burnt gases imprisoned in the cushion space *F* to a pressure greater than that due to the static head in *ET*. The water moves outward a second time; when it reaches the level of the valve *E* the pressure in *F* is again atmospheric. Further movement of the water opens valve *A* against a light spring and draws in a fresh charge of gas and air. Once more the column of water returns under the elevated tank pressure and compresses the charge of gas and air, which is then ignited to start a fresh cycle of operations. The action of the pump is not altered if, instead of delivering into an elevated tank, it discharges into an air vessel or into an open standpipe or tower. This is the type of pump which was shown in operation at the Brussels Exposition, and which obtained the highest possible awards both in the gas-engine class and in the pump class. The valve mechanism of this pump Mr. Humphrey describes in detail.

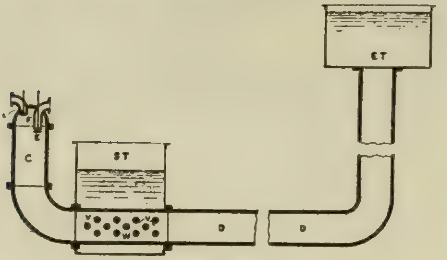


FIG. I.

The fact that in the Humphrey pump the burnt gases are so well cooled at the end of the long expansion stroke that they will not ignite an incoming combustible charge makes it possible to have a true two-cycle pump. Figures 2a and 2b show alternative arrangements of the top of the combustion chamber for a two-cycle pump. The combustion chamber has to be specially shaped so that the incoming charge, which may be preceded by pure air, displaces the burnt products and mixes as little as possible with them. In Figure 2a, *A* is the admission valve at the top of a tall but narrow part of the chamber *B*, in which the full charge volume extends down to the level *c c*. A number of exhaust valves *E* lead to a common exhaust outlet *O*, which may be fitted with a non-return valve, or each exhaust valve may carry a light non-return valve on its spindle, as shown. The level at which expansion reaches atmospheric pressure is, say *f f*, but this level having been reached by the water its further movement draws in fresh combustible mixture till it occupies a space down to *c c*, and the liquid level has fallen to *g g*. The column of liquid now returns and drives the exhaust products through the valves *E* (which opened by their own weight) until these valves are shut by the water. The kinetic energy acquired by the column is now spent in compress-

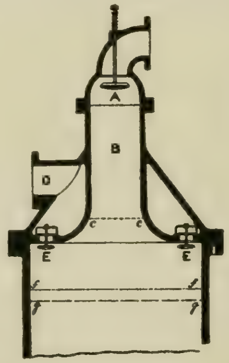


FIG. 2a.

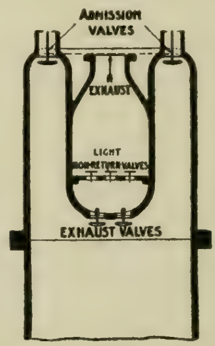


FIG. 2b.

ing the fresh charge, which is ignited to start a new cycle. Thus each out stroke is a working stroke, and no locking gear is required on the valves. The same cycle applies to Figure 2b, but in this case there are a number of admission valves placed in a ring so as to allow the mixture to enter with a low velocity, in order to prevent eddies and mixing with the exhaust products. The advantage of the cycle is that a higher compression pressure is obtained than with the simple pump, and consequently higher efficiencies with the same lift.

Figure 3 illustrates the double-barrel pump, the cycle of which may be readily surmised. Explosion occurs alternately in the two combustion chambers *A* and *B*, and in each chamber there is the usual cycle of compression, explosion, exhaust, and the taking in of a new charge, thus again involving four strokes of unequal length. In this case, the water column has only one outward and one inward movement per cycle, but the expression "two-stroke" could be applied only to the water column, and not to what occurs in the combustion chambers.

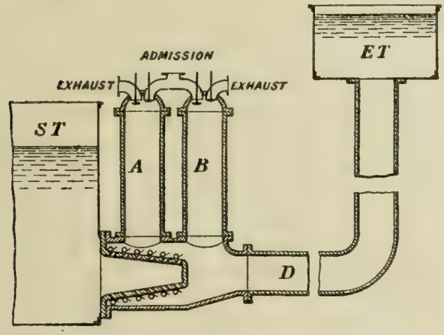


FIG. 3.

The action of this pump differs from that of the simple pump first described in that the new charge is taken in merely by water falling under the action of gravity, and does not depend upon the compression and expansion of an elastic cushion; hence the clearance spaces at the tops of the combustion chambers may be reduced to the very small volume needed to bring easily to rest that portion only of the column which rises in the chamber, the main body of the column being brought to rest by the compression of the new charge. The advantages of the two-barrel over the simplest of the single-barrel pumps are three: higher explosion pressure for the same water lift, due to the increased purity of the charge caused by the decrease in clearance space and to the higher compression pressure; increase of the number of cycles possible in unit time; and greater output for a given total weight of pump and play pipe.

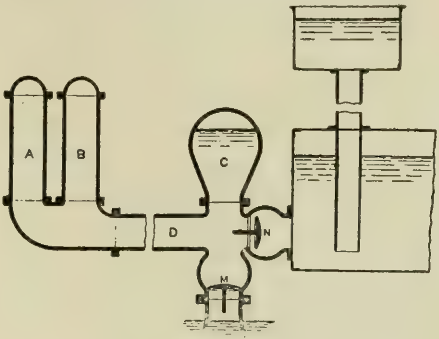


FIG. 4.

Five types of single- and double-barrel suction-lift pumps are described by Mr. Humphrey, one of which is illustrated in Figure 4. On explosion in *A* the water column moves outwardly from the chambers and compresses the air in *C* until the pressure is sufficient to lift valve *N* and pass water into the high-level tank. On the column coming to rest, valve *N* shuts and the compressed air in *C* expands again, imparting velocity to the column, and enabling the expansion to pass below atmosphere, and so lift water from the low-level tank at the same time that exhaust in *A* and compression of the new charge in *B* take place. The cycle is then repeated.

Coming now to high-lift pumps, any Humphrey pump, whether single or double barrel, may be converted into a high-lift pump by means of an air vessel fitted with valves and called an "intensifier." The idea is first to allow the water column to gain velocity and then to utilize its kinetic energy to compress an elastic fluid and to deliver water under the pressure to which the elastic fluid has been compresed. Figure 5 will make the cycle clear. At the end of the play pipe *D* of a two-barrel pump are two air vessels *E* and *F*, the latter large enough to give a continuous flow at outlet *O*, and to maintain a practically uniform pressure. *E* is fitted with a pipe *K*, open to the atmosphere at the top and carrying a valve *L* at its lower extremity arranged to close under the action of the rising water. The cycle starts with explosion, all valves except *L* being shut and the water level as shown. The column of water rising in *E* gains speed until valve *L* is shut by impact. The air in *E* is then compressed until its pressure is sufficient to cause the high-pressure water valves *W* to open. Water is now forced into *F* until the column comes to rest, when the valves *W* close. The return flow, caused by the expansion of the compressed air in *E*, exhausts *A* and compresses a fresh charge in *B* to start a fresh cycle. Valve *L* opens when the water level falls below it and air is admitted into *E* for the rest of the return stroke.

If the pipe *K* is made vertically adjustable with regard to *E*, any desired quantity of air can be entrapped in *E*. Since the degree of compression is maintained constant by the pressure in *F*, the amount of energy stored in this air will vary directly with the quantity. Hence, the ratio of the total energy of the working stroke to the energy stored in the compressed air in *E* can be made anything desired, or, in other words, we can obtain any desired pressure of the new charge in *B* entirely independent of the water lift. By manipulating the position of valve *K* a given pump can thus be made to meet any conditions as to height of lift.

An important development of this arrangement is made by connecting *K* to a supply of combustible mixture instead of allowing free opening into the atmosphere. *E* then becomes an automatic pump for taking in mixture and discharging it under pressure. If the discharge is into a reservoir from which combustion chambers *A* and *B* can be supplied, we have at once a means of quickening the cycles and greatly increasing the output of an apparatus of a given size. The 1,000 horse-power pump now under construction in Germany will operate on this principle.

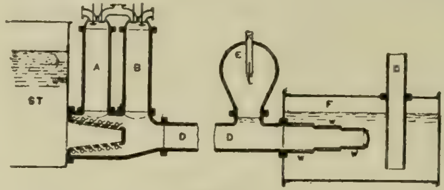


FIG. 5.

If the column of water oscillating in the play pipe of a Humphrey pump is used as a water piston, and caused to rise and fall in an air vessel fitted with suitable valves for the inlet and outlet of air, the combination constitutes an air compressor of a very efficient type and of the greatest possible flexibility. As mentioned above, the operation of the Humphrey compressor has already been described in these columns. We must refer our readers for details to the review in our issue for January, 1910, or to Mr. Humphrey's paper. We may say in passing, however, that all the conditions of output, up to the full limit of the compressor, may be governed at will, and for all ranges the compression pressure of the new charge may be kept up to the required degree, so that the apparatus works at its maximum efficiency throughout its whole range.

With regard to the efficiency of the Humphrey pump, with a compression pressure of eleven atmospheres absolute, the theoretical thermal efficiency of the cycle is 52.5 per cent, whereas that of the Otto cycle is only 40 per cent when all corrections for varying specific heats are allowed for. Such compression pressures have not yet been adopted, but they will be employed in the 1,000 horse-power pump already referred to. In the meantime, when using only very moderate compression pressures of under 50 pounds per square inch, an actual thermal efficiency of over 23 per cent has been obtained on a four-cycle Humphrey pump. This corresponds to 0.95 pounds of anthracite per hydraulic horse-power hour, and was obtained on a lift of only 35 feet. There is every reason to believe that when the compression pressure reaches that employed in ordinary gas engines, the best efficiencies attained in gas engines will be reached and probably surpassed by the Humphrey pump.

In concluding his paper, Mr. Humphrey discusses briefly the application of the Humphrey pump for the purposes of marine propulsion. The theoretical efficiency of the jet propeller is well known and admitted. The trouble has been to find a pump which would be at once pump and engine combined, and which would handle large quantities of water so that the area of the jet at the point of exit might be comparable with the area of the water acted upon by an ordinary screw propeller. Mr. Humphrey believes that his pump fulfils the required conditions, and he offers a diagram showing one possible arrangement.

STREET LIGHTING WITH TUNGSTEN LAMPS.

DATA OF THE SAVINGS EFFECTED BY THE SUBSTITUTION OF TUNGSTEN LAMPS FOR INCANDESCENT GAS LAMPS IN THE BOROUGH OF ST. MARYLEBONE, LONDON.

Haydn T. Harrison—Institution of Electrical Engineers.

A TEST of the economy of the tungsten lamp in street illumination has been made on a large scale by the Borough of St. Marylebone, London, which recently replaced nearly two thousand gas lamps with pairs of 35-watt and 55-watt Osram lamps. Full data of the installation and of the savings effected are given in a long paper by Haydn T. Harrison, read late last November before the Institution of Electrical Engineers. Mr. Harrison dealt comprehensively with the subject of modern street illumination by electricity, and his data were not confined exclusively to the St. Marylebone installation nor to incandescent lamps. The abstract following, however, which is taken from *The Engineer* for December 2, 1910, is limited to a consideration of the savings effected by the tungsten lamps at St. Marylebone.

In order to ascertain the illumination given by the gas lamps, an outside testing authority, intimately connected with the gas industry, was instructed to test at random 100 street gas lamps in the district. The results showed an average for the single 4½ cubic feet mantles of 50 candlepower and 76.6 for the double mantles. The author also carried out a similar test, and with the single mantles he obtained an average of 45 candlepower and with the double 76 candlepower. It was decided that the single lamps should be replaced by two 115-volt 35-watt Osram lamps in series, and the double lamps by two 55-watt lamps. The existing gas lamp-posts being the property of the Council, and having been maintained in good condition, it was decided to retain them. The light from the tungsten lamps having a profile curve favourable to street lighting, it was only necessary to accentuate this by means of reflectors.

On the other hand, the use of something which would counteract the effect of high intrinsic brilliancy of the light source on the iris of the eyes was considered desirable, and a properly designed so-called reflector was, therefore, adopted. It was estimated that the capital cost of converting 1,964 lanterns and connecting them to existing distributors would be £8,000, but it is stated that the work was actually done for £5,788, or an average of less than £3 per post. The work was completed in three months, which represents an average of nearly 200 posts a week. The excellent results obtained have led the Council to decide to convert the remaining 1,385 lanterns in the district, but, owing to these not being adjacent to existing distributors, new ducts and mains were necessary.

As these would eventually have to be laid for private lighting and power supply, it is difficult to allot the right amount of capital charges to the public lighting, but the author states, even if the whole of this were allotted to public lighting based on a twenty-five year loan, and the cost of the electric fittings be repaid in three years, £1,640 would still be available for electric supply, if the existing gas rate were still charged for lighting. This is equivalent to .9d. per unit for the first three years, and 1.17d. per unit thereafter. The 1,964 lamps, when lighted by gas, cost the Council for gas, lighting, extinguishing, cleaning, and maintenance, £8,818 per annum. The gas contractors, when asked for a revised tender, reduced their price considerably, but were unable to compete with the tenders of the electricity department, which amounted to £7,350 per annum, made up approximately as follows:—

	£.	Per post. £.	s.	d.
A. Electrical energy at 1.42d. per unit	3,950	2	0	0
B. Lighting, extinguishing, cleaning, painting, etc.	1,570	0	16	0
C. Lamp renewals	1,230	0	12	6
D. Repayment of cost of electric light fittings in three years.	600	0	6	6
Total	7,350	3	15	0

It should be remembered that 1,964 street lanterns included in this charge contain lamps of various candle-powers, as shown by the following table:—

	Measured at 20 degrees.	Candle-power at 10 degrees.
335 two 80-watt lamps	135	220
491 two 55-watt lamps	75	130
1,138 two 35-watt lamps	55	100

The proportionate cost of each lamp per annum is approximately as follows when taking energy at 1.42d. per unit:—

	70-watt. s.	d.	110-watt. s.	d.	160-watt. s.	d.
A	28	6	45	0	64	0
B	16	0	16	0	16	0
C	12	0	12	0	15	0
D	6	6	6	6	6	6
Total	63	0	79	6	101	6

In the above figures the price charged per unit is 1.42d. This figure was not arrived at with any idea of the cost to the electricity department, but in order to repay the cost of the services at an early date. It will be noted that if the charge per unit had been 1d., which is more consistent with the cost of generating, the sum of £3,950 per annum would be reduced to £2,780, which allows £1,170 per annum for repayment of cost of services, etc., the cost of the repayment of the fittings being already allowed for. This will easily wipe off the cost of the services in five years.

The author points out that, as a consumer, a street lamp is very attractive, the load factor is good, no expensive meters or other apparatus are necessary, and it is not likely to have to be cut off owing to termination of tenancy or vagaries of that description. By the introduction of these metallic-filament lamps in Marylebone a saving of £1,500 a year has been made in the lighting rate, and at the same time the illumination of the streets has been improved. The 1,964 gas lamps gave a total of 109,000 candle-power, and the 1,964 electric lamps gave a total of 146,000 candle-power at 20 degrees, and 193,883 at 10 degrees. The illumination has naturally been increased directly in proportion to the increase of candle-power, as the position, height, etc., of the lamps remained the same.

Whilst discussing highly illuminated streets and the use of high candle-power units of light the author makes reference to the use of high-pressure gas lamps, and draws attention to some tests which were carried out by Mr. J. Morris, from which the latter gentleman draws the conclusion that the high candle-power of a high-pressure gas lamp varies 50 per cent., depending on the quality and pressure of the gas. His figures show that from 30 to 34 candle-power per cubic foot of gas consumed per hour is a very average result when working at a pressure of 4 inches of mercury. As the author's own figures tend to corroborate this, he takes as an example a 1,500 candle-power Keith lamp, which gave on test between 720 and 780 candle-power with a consumption of 23 cubic feet per hour. This, compared with a flame arc lamp giving 5 candle-power per watt at 1d. per unit, would have to be supplied with gas at 7d. per 1,000 cubic feet in order to produce the same light for equal cost, and the author therefore points out that even high-pressure gas lamps do not compare favourably in cost, which embody the improvements of the last few years.

Among other interesting points which the author touches upon is the use of open type arc lamps and tungsten lamps.

He states that two districts bordering on Marylebone are lighted by the former, in each of which nearly 1,000 of these lamps were erected, and are still in use. In one of these districts, where they are spread over nearly 25 miles of streets, the cost per mile of lighting is about £880, the minimum illumination resulting in this case being .05 candle feet. Reference to the Marylebone figures, where the same class of street is illuminated by means of the tungsten lamps, shows that with a minimum illumination of .08 candle feet nearly half as much again is obtained at a cost of £414 per mile, or less than half. In the other neighboring district the arc lamps are spread over nearly 37 miles of streets, and are arranged to give two different degrees of minimum illumination, namely, in the important thoroughfares .012 candle feet and .008 in the other thoroughfares. At the prices charged this works out at about £450 and £350 per mile respectively. Comparing this with Marylebone, where the illumination even of the side streets is more than double the first degree and sometimes even triple the first degree, the cost does not exceed £204 per mile.

MAGNETIC ALLOYS FROM NON-MAGNETIC MATERIALS.

AN INVESTIGATION OF TERNARY ALLOYS OF COPPER AND MANGANESE WITH ALUMINIUM, TIN, ANTIMONY AND BISMUTH.

Alexander D. Ross—Institute of Metals.

ON the basis of their magnetic properties, metallic elements are commonly divided into two classes—"magnetic" and "non-magnetic." In the first class are placed iron, nickel and cobalt, the three simple metals which exhibit in a marked degree the phenomena of magnetic attraction and repulsion and of permanent or residual magnetism. While the other elements are placed in the "non-magnetic" class, many of them are not strictly non-magnetic. Under the action of powerful magnetizing forces they exhibit polarity, although the magnetism induced in them is relatively very small and generally vanishes with the removal of the magnetizing force. Such metals are more accurately described as "para-magnetic" than as "non-magnetic," and the special term "ferro-magnetic" has been introduced to denominate materials highly magnetic and retentive.

Within recent years the study of the magnetic properties of alloys of two or more elementary metals has had important commercial results. It has been found, for example, that chrome and tungsten steels possess great retentivity, and are especially suited to the manufacture of permanent magnets. Further, the addition of silicon or aluminium to iron produces, in certain cases, a material of high susceptibility to magnetization and of low hysteresis loss, particularly valuable in the manufacture of transformers. Of still greater importance, from the theoretical point of view, was the discovery that by alloying together the two ferro-magnetic elements nickel and iron in the proportion of one to three, a non-magnetic material is produced. The reverse phenomenon, the production of a decidedly ferro-magnetic material by the alloying of non-magnetic or para-magnetic elements, was unknown until 1903, when Heusler announced his discovery that certain binary and ternary manganese alloys show considerable ferro-magnetism. Alloys of manganese with aluminium, arsenic, boron, bismuth, antimony, and tin were found to possess magnetic properties, which they retain when copper is added, the ternary alloy in some cases being more strongly magnetic than the binary material. The most remarkable of these ternary alloys are those of the copper-aluminium-manganese group, commonly referred to as the Heusler alloys, which have been widely studied. Certain members of this group have a saturation intensity of magnetization equal to about 80 per cent. of that of pure nickel; in low fields they are as permeable as cast iron.

Little attention has been given to the ternary alloys of copper and manganese outside the aluminium group. The first record of tests on any considerable scale is contained in a paper read by Alexander D. Ross before the Institute of Metals last September, which is reprinted in *Engineering* for November 4, 1910. Prof. Ross' investigation, which has been in progress since 1905, has comprised a detailed examination of the properties of one of the most highly magnetic of the copper-manganese-aluminium group—in particular, of the effects produced by varying thermal treatment; an investigation of other members of the same group, and of ternary alloys of copper and manganese with tin, antimony, and bismuth; and fianally an investigation of binary alloys of copper with manganese and aluminium, and of manganese with antimony and boron, for the elucidation of the more complex phenomena of the ternary alloys.

The materials used in the preparation of the alloys were of the highest possible degree of purity. In the preparation of the ternary alloys, the plan adopted was to make first a copper-manganese alloy (usually in the proportion by weight of seven to three) and then to add the third metal to it. The test bars were cylindrical rods, 9 inches long and 7/16 inch in diameter, cast vertically in dry sand moulds. The binary alloys, being too feebly magnetic to test by the usual methods, were cast as small rods measuring 4½ inches long and ¼ inch in diameter. The bars were in all cases made sufficiently long to permit the rejection of a small piece from the lower end, and also the cutting of two samples for chemical analysis, one from either end.

The apparatus used in the tests comprised a special type of magnetometer designed by Dr. J. G. Gray and Prof. Ross, an electric furnace for use within the magnetizing solenoid, and a platinum and platinum-iridium thermo-couple. The programme of the tests was as follows: (1) To determine the magnetic quality of the alloys in the condition as cast; (2) to find the simplest and most efficient heat treatment for bringing the alloys into a stable condition with the highest possible magnetic quality; (3) to investigate the changes produced in the magnetic properties by exposure of the alloys to different temperatures, and incidentally to determine the critical temperature and investigate the reversibility of the thermal treatment; and (4) to examine the effects produced by quenching, annealing, and baking the alloys.

The alloys to which reference will be made had the following percentage compositions:—

	Percentage composition.			
Alloy.	Cu.	Mn.	Al.	Sn.
1........	75.5	16	8	....
2........	62	25	12.5	....
3........	54	30	15	....
4........	60.2	25.1	....	14.1
5........	58.7	23.5	....	16.1
6........	57.6	24.9	....	18
7........	49.2	20.4	....	29.8
8........	43.4	18.1	....	40
9........	36.4	15	....	48.1

Alloys 2 and 8 were the most strongly magnetic in their respective classes, and the results of tests on these two alloys will be used as a standard of comparison in what follows.

The alloys were first tested as cast, without any preliminary dressing operations save only the removal of the end portions, at room temperature (15 degrees C.), and at the temperature of liquid air (—190 degrees C.). The results of the tests on alloys 2 and 8 were as follows:—

	Intensity of Magnetization.			
	Alloy 2.		Alloy 8.	
Applied field, H.	15 deg.	n 190 deg.	15 deg.	n 190 deg.
20........	254	300	21	21
50........	292	358	53	53
100........	310	388	95	95
200........	324	401	159	160
Residual....	85	160	11	11

While the effect of cooling to the temperature of liquid air is large in the case of aluminium alloy 2, and practically imperceptible in the case of tin alloy 8, the effect varies greatly in different members of the same series. The percentages of improvement in intensity of magnetization corresponding to a value of H of 100 for alloys 1 to 9 are, respectively, 20, 25, —1, 21, 26, 35, 1, 0, and 0. The general improvement in intensity is a characteristic feature of these alloys; most of the magnetic materials, such as iron, steel, iron alloys, nickel, and cobalt, are in general less susceptible to magnetization at low than at normal temperatures.

The majority of these bronzes are improved in quality by exposure for some time to temperatures between 150 degrees and 200 degrees C. Usually the improvement has a double origin—the removal of initial stresses, and a constitutional change into a new equilibrium condition, and in most cases it can be effected in two steps, corresponding to the two distinct processes involved. When the internal strains are removed by heating to, say, 180 degrees C. and cooling slowly, the alloy is merely "normalized," without any change in its initial magnetic properties save a slight increase in intensity which is uniform throughout the magnetization curve. Heating the alloy for several hours at a temperature of 180 degrees C. before the slow cooling to room temperature produces a constitutional change in the material, which is altered from a metastable condition towards the true equilibrium condition corresponding to temperatures not far from room temperatures. In the case of the aluminium alloys, normalizing has little effect, but a considerable increase in the saturation value of I (amounting in the case of alloy 2 to 10 per cent. without increase in hysteresis) can be obtained in some instances by annealing at 170 degrees C. for six to eight hours. In the case of the tin alloys, on the other hand, normalizing often produces a decided improvement, while annealing or baking results in an increased hysteresis loss more than counterbalancing any slight improvement in susceptibility.

After quenching at high temperatures, the aluminium alloys are always less magnetic, but the coercive force, and consequently the hysteresis, are greatly diminished. Coercive force varies greatly in different materials: in very soft iron it is 1.7 C. G. S. units, and in quenched tungsten steel 50 units. The coercive force of alloy 2 is reduced from 1.3 units to less than 0.3 units by quenching at 550 degrees C. By quenching at 400 degrees C. the coercive force of alloy 8 is reduced from 9 units to 6 units. If the quenched aluminium alloys are left at room temperature for several months they gradually recover their magnetic quality and finally attain a permeability little less than that which they had previous to the quenching, with no appreciable increase in the small value of the coercive force. Alloy 2 treated in this way has fair permeability and extremely little hysteresis loss, and is at least an approximation towards the ideal magnetic substance.

The quenching phenomena of the tin alloys are more complex. Quenching at temperatures high above the critical temperature renders the material almost non-magnetic, but at moderate temperatures the alloys are almost as magnetic as before quenching. An interesting point in regard to the quenched alloys of both groups is that they are nearly all more sensitive to temperature variations than they were in the unquenched condition. We have given above for alloys 1 to 9 the percentages of improvement in intensity of magnetization corresponding to a value of H of 100 when the alloys are cooled from 15 degrees C. to —190 degrees C. The corresponding values for the same alloys when quenched are 400, 33, 50, 25, 33, 35, 5, 9, and 5.

Tests of the magnetic properties of the cast or normalized alloys at successively increasing temperatures until the critical point was attained and at successively decreasing temperatures from the critical point to room temperature have demonstrated that the magnetization of the tin alloys is reversible, while that of the aluminium alloys is not reversible. The latter are much less magnetic at each definite temperature during the cooling process than they were at the same points during the heating. The critical temperatures of the tin alloys range from 220 degrees C. to 280 degrees C., while those of the aluminium alloys are, respectively, 280 degrees, 500 degrees, and 345 degrees C.

Copper-manganese-antimony alloys have properties very similar to those of the aluminium alloys. The bismuth bronzes, however, differ from the others in that quenching at 300 degrees C. makes the materials much more magnetic (in one case the increase was over

60 per cent.), increases the retentivity of the alloys and increases also the coercive force.

Tests of the binary alloys show that copper-manganese containing about 30 per cent. of manganese is more retentive after quenching than in the cast condition, in which it differs essentially from the aluminium and tin ternary alloys. On the other hand, an alloy containing about 10 per cent. aluminium and 90 per cent. copper exhibits the improvement on cooling to the temperature of liquid air and the deterioration on quenching characteristic of the ternary aluminium alloys. This 10 per cent. aluminium bronze differed from all the others tested in that it contained the intermetallic compound Cu_3Al. As alloys approximating in composition to this formula are apparently the most magnetic of the aluminium-copper series, Prof. Ross suggests that this compound plays an important part in the magnetism of the copper-manganese-aluminium bronzes. The magnetic properties are due, he says, to the formation of solid solutions, of which the comopund Cu_3Al is a constituent. Mn_3Al is known to be the most magnetic of the manganese-aluminium alloys. It is possible then that a series of solid solutions occur between the compounds Cu_3Al and Mn_3Al, and give rise to the ferro-magnetism of the ternary alloys. Owing to the difficulties of testing, however, one cannot be certain as to whether the solid solutions are formed merely between Cu_3Al and Mn_3Al, or whether uncombined manganese enters into them. Prof. Ross has undertaken a metallographic investigation to clear up this point. As to the magnetic properties of the copper-manganese-tin alloys, Prof. Ross believes them to be explicable on a similar theory of the formation of solid solutions.

THE TRAINING OF YOUNG ENGINEERS.

PRACTICAL SUGGESTIONS OF VALUE TO MANUFACTURERS AND EMPLOYERS, AS WELL AS ENGINEERING GRADUATES.

Melville W. Mix—The Purdue Exponent.

WE have heard much in recent years of the remarkable advance that Germany has achieved, through her technical and manual training schools, in the preparation of young men for both industrial and commercial callings. But this deserved commendation of educational methods has seemed to leave out of account the very rapid advance which American manufacturers have been making, not alone in the adoption of scientific methods of management and operation, but especially in the employment and practical training of young men who have graduated from technical schools and colleges. And in no field is this advance made more evident than in the multiplication, enlargement, and very great improvement of the technical schools and colleges of the United States.

A notable instance of this is shown at Purdue University, Lafayette, Indiana. Beginning in 1880, former Dean W. F. M. Goss established an engineering school in a little basement in one of the University structures. This modest experiment found such immediate popular approval that first one, then a second, and finally a third new building was erected for the necessary accommodation of the rapidly-growing classes. Now it has been found that an entire new group of buildings is necessary to accommodate the Department of Practical Mechanics, and provide facilities for instruction in mechanical drawing, descriptive geometry and shop work. The main building contains 25,000 square feet of floor space; can accommodate at one time 400 students in drawing, and has locker accommodations for 1,200 students. The shops cover 43,000 square feet of ground and are capable of accommodating a group of 350 students at one time. The machines, tools, benches, lockers, in fact, all the details of the equipment are modern, while many of the special features are unique. The buildings as a whole constitute what is probably the largest and most completely equipped plant for the instruction of students in shop practice and drawing in America and represent the accumulated experience of twenty-five years at this university. To teach manufacturing in the broader sense, rather than manual training, is the object ultimately sought in the construction and use of these buildings.

This special group of buildings was completed during the past summer, and the dedication exercises were held in November. Mr. Melville W. Mix, President of the Dodge Manufacturing Co., Mishawaka, and also President of the Manufacturers' Bureau of Indiana (numbering 1,000 members and representing all the leading industries of the State), was the principal speaker upon that occasion; and in the course of his address he offered practical suggestions of so much value to manufacturers and employers, as well as engineering graduates, that we take pleasure in reproducing here the main portion of his address.

Speaking first from the standpoint of a manufacturer and employer, Mr. Mix said: "No better evidence of the high esteem in which Purdue University is held by the manufacturers of Indiana need be stated at this time than to call attention to the large number of graduates of this institution which are now employed by manufacturing and mining companies, municipalities, public utilities and transportation corporations of this State. I do not believe there is an important institution of any of these divisions of engineering that has not one or more Purdue engineers occupying important positions. One needs only to look over the transactions of the Indiana Engineering Society to receive further proof of the high places occupied by Purdue graduates. And 'there is a reason.' The training here has been thorough and practical, and I marvel at the results that have been attained with the former meagre equipment. When Purdue men leave this place they are fitted to 'do things.'

"I mentioned to Dean Benjamin the other day when he was up to Mishawaka, that it seemed easy to get large sums appropriated for agricultural development, but that the engineering section seemed to have a hard time with the Legislature, and asked the reason. He said it was a very simple matter—that the farmers were so well organized through their various granges that he could get the support of 30,000 farmers inside of 24 hours. Now that we know how it is done, I am glad to assure you of an organization of manufacturers—the Manufacturers' Bureau of Indiana—that has a membership of nearly 1,000, representing every manufacturing district of the State. That will also be reachable in 24 hours, or quicker if necessary. We were only half as effective at the last session as you wanted us to be, but we shall hope to secure a more liberal appropriation next time if you can show correspondingly good results.

"Indiana demands substantial recognition in this field because of the great development in manufacturing that is taking place in this State. It may be well to call your attention to the fact that the American center of manufacturing, as well as of population, is in Indiana. No more strategic position is occupied by any State than is enjoyed by Indiana when it comes to assembling materials, cheap power and high-class labor, by means of which we may produce a wide range of manufactured articles and distribute them economically to all of the principal markets of this continent and of the world.

"Then, there is another reason why we should build and maintain the greatest technical university in America—we need the men in our business; they are our home boys and we have the opportunities open for them. All we ask is that they take advantage of these openings by absorbing all you can teach them here; then let them get into the real game. There is no more interesting game in the world than manufacturing. The greatest opportunities are afforded for the development of any talent the young man may possess. The manufacturers don't have much trouble getting men for positions but they do have trouble in making them stick and become masters of their work. They nearly all want to be general superintendents, consulting and supervising engineers, and attach a lot of other high sounding titles to their names as soon as they have learned how to ring in on the shop clock.

"The dirt and noise of the mill is distasteful to many who would otherwise make good; but I want to tell you boys, that is where 'we need the goods.' Don't be in too big a hurry to put on a stiff collar and have a stenographer and a string of push buttons. Most of the success of to-day has been earned from the bench and glare of the furnace. The association of men in their daily work is a most important factor; it serves to knock the frills off many a good chap, and brings him to the point of respecting a horny palm and an honest, industrious heart wherever it is found. And, generally, he is the fellow who knows his business from stem to stern. He has had his apprenticeship in the College of Hard Knocks—an institution that knows no favor, and you will want to know him better.

"This institution is a fitting climax to the educational prowess of Indiana. Industrial education is the thing today—beginning in the kindergarten, then through manual training, and later through shop apprenticeships to the colleges and engineering laboratories, until we find it the most important feature of our national development.

"I shall hope that it may be a part of your educational plan to extend the feature of specialization—perhaps in a way of post-graduate courses. It is essential that industrial engineers be educated in cost-keeping, production, engineering, sales promotion, piece and premium work, and other labor problems. It is to be hoped that special chairs may be provided for teaching these collateral subjects to industrial engineering, for therein lies the greatest function that such an organization as this can perform."

THE FIELD FOR GRINDING.

A DISCUSSION OF THE ECONOMY OF GRINDING IN CERTAIN CLASSES OF WORK, IN COMPARISON WITH THE REMOVAL OF METAL BY TURNING OR MILLING.

C. H. Norton—American Society of Mechanical Engineers.

GRINDING processes and grinding machines were the subject of three papers read at the annual meeting of the American Society of Mechanical Engineers last month, and discusses in a special session of the Machine-Shop Section. The topic was introduced by a paper by C. H. Norton on the field for grinding, which is abstracted at some length below. We reserve the papers by W. A. Viall, on precision grinding, and B. M. W. Hanson, on modern grinding methods, for subsequent consideration.

Mr. Norton first shows the fallacy of the common idea of grinding as a slow, tedious, and laborious process. "The fact about grinding with the modern grinding machine and grinding wheel (not emery wheel)," he says, "is that it enables us to size all round work cheaper than by turning and filing, that it takes the place of what we formerly called the finish cut of the lathe and all filing, giving us not a theoretically perfect cylinder or perfect finish, but a much nearer perfect cylinder and finish than we obtained with the lathe. It gives us diameters to such small limits as to be called exact, but whoever insists that none but exact work be ground loses the very pith of grinding, which is economy. Modern grinding means cheaper cost for all work, many grades of work to suit many requirements, and cheaper turning than is possible without the use of the grinding machine.

"As a rule, the coarser the turning the greater the economy by grinding. The greatest economy is obtained by the combination of cheaper turning and grinding. It is no longer necessary to turn work smooth, straight or correctly to size and the lathe is no longer necessary as a precision tool. If it has a carriage traverse of from four to ten threads per inch, has sufficient power to carry high-speed tool cuts at that feed and is well supplied with steady rests to prevent springing of the work, it is ready for co-operation with the grinding machine. It is easier with modern grinding machines and wheels to grind off a given amount of metal when in the form of crude screw threads than in any other form, and with long work having several sizes the grinding requires less time if 1/32 inches to 5/64 inch is left on the diameter for grinding than if the work is turned carefully to within 0.002 in. to 0.005 inch. In all cases, accurate turning increases the total cost of production and in some it makes the grinding very expensive. The greatest economy is usually obtained by the combination of grinding with very rough turning. Yet there are cases where the least expensive way is to grind direct without turning, notably the greater part of crankshafts of automobiles and small gas engines and very long and slender work where turning is difficult.

"It is not an easy matter to secure such rough turning as true economy requires in connection with grinding. Lack of knowledge of what is needed, coupled with the natural pride the workman takes in doing what tradition says is nice lathe work, prevents the grinding machine from doing what it is ready to do. Lathe men have not tried to remove metal by increasing the number of cuts and using fast traverse. When urged to take coarse feeds to help the grinding machine to effect a total saving, they have invariably said that they were feeding all that the work would stand. It has been demonstrated that three cuts with a carriage traverse of 6 per inch has produced certain work in 9 minutes that required 13 minutes to turn in one cut, because the work was so frail that with one cut no faster feed than 32 per inch could be taken. The rough-ridged surface was readily ground by taking 1 minute more than when the turning was finer, the net saving for the job being 3 minutes. In many cases the ridged surface requires no additional time. . . .

"There is a rich field for engineers and managers in connection with the lathe and modern grinding. Recent lathe designs provide for high speed of revolution, with sufficient power, quick change to and from back gears, and sufficient rigidity to utilize to the limit high-speed steel; but much work is not of sufficient rigidity to permit the maximum use of the tool at fast traverse and deep cuts. In addition, there are thousands of lathes of old design that will not be thrown away at once. There is, therefore, an opportunity to get much more out of present plants by cheaper turning, *because of grinding.*

"Developments warrant the conclusion that we should no longer assume that simply because a tool is a grinding wheel it cannot remove metal and size and shape work as quickly as a steel tool. Rather, we should use the steel tool when it can be made to remove metal, size and shape work cheapest, and the grinding wheel when it excels. It is no longer to be taken as a matter of course that we can turn, plane and mill faster than we can grind. After all, the real reason we remove metal is to accomplish certain finished results, not simply to secure a certain number of pounds of chips in a given time. Before long I think all progressive engineers will understand that both the grinding wheel and the steel tool have their place for metal cutting. The old thought of abrasion must give way to the new thought of cutting.

"While it is still true that poor wheels or good wheels poorly selected and wrongly used will still remove metal very slowly by abrasion, it is also true that the old-fashioned milling cutter, with fine teeth cut by hand with a file, hardened but never ground, and used in the old-time slender milling machine, would very slowly abrade the surface. The modern grinding wheel, used in a modern machine by a modern man, is just as surely a milling cutter as if it were made of steel." The microscope reveals the fact that the grinding wheel removes the metal in the form of chips, similar to those produced by the lathe and milling machine.

"The grinding wheel as now made is really a milling cutter with millions of cutting teeth. Although these teeth are not as large or as strong as the teeth of a steel cutter and therefore cannot cut as deeply, yet they are capable of cutting at much greater speed. Since there are so many more of them they are capable of much more work in a given time when the nature of the work is such that a large number of these cutting points can be used simultaneously. In some cases we can use as many as two billion cutting points per minute. Eight hundred million per minute is not uncommon and four hundred million per minute is very common. The modern grinding wheel, mounted in a good machine, can be used at a cutting speed of 6,000 or more surface feet per minute and owing to this high speed it need not cut deeply relative to the rigidity of the work. Therefore it is able to remove metal from many forms of work more quickly than the milling cutter or the lathe tool." Mr. Norton describes particularly the manufacture of automobile cams from bar stock, and the finishing of pins and bearings of automobile crankshafts, and illustrates a number of other classes of work in which the grinding machine is more economical than the lathe or milling machine.

"Automatic grinding is a late development in the field. Certain work of which large numbers of pieces are made is ground by wholly automatic means. The work is conveyed to the machine by gravity in a hopper or chute and is chucked, ground and delivered to the receptacle. In a case where formerly, at piece work, 300 per day were ground, the automatic machine grinds 4 in a single minute, about 2,300 per day. When the knowledge of grinding becomes more common and the opposition to increased production on the part of the workmen shall have been more nearly overcome, the field will be still more extended. It is worthy of more systematic co-operation and if we get together we will be rewarded with success. The engineer is the one who by education and training is best fitted to take up the important question of the field for grinding and its possible economies."

TRANSMISSION OF HEAT IN SURFACE CONDENSATION.

A SUMMARY OF THE RESULTS OF A RECENT INVESTIGATION COVERING THE WHOLE THEORY OF HEAT TRANSMISSION THROUGH CONDENSER TUBES.

George A. Orrok—American Society of Mechanical Engineers.

So long as small condensers and vacua of over two pounds absolute were the rule, designers of surface condensers were not seriously hampered by the diversity of the theories formulated by the various investigators of the laws of heat transmission through condenser tubes. But since the development of the steam turbine has caused a demand for condensers of large capacity working at vacua of less than one pound absolute, the lack of more accurate knowledge of these laws has been seriously felt. It is now made available by George A. Orrok, who has been enabled by the liberality of the New York Edison Company to complete a careful investigation of the whole theory of heat transmission through condenser tubes. Mr. Orrok's results and conclusions were reported in a long paper read before the American Society of Mechanical Engineers at the recent annual meeting, and are printed in the *Journal* for November, 1910.

The theory of the transmission of heat through metallic tubes from condensing steam to water as stated by previous investigators may be summarized as follows: "(1) The quantity of heat transmitted by a unit of surface in unit time is proportional to the temperature difference (Joule, Rankine and most of the experimenters), or to the square of the temperature difference (Werner, Grashof and Weiss) between the media on the different sides of the tube; (2) the quantity of heat transmitted is proportional to some power of the water velocity ($V^{1/3}$ by Joule and Ser, $V^{1/2}$ by Hagemann and Josse, V^1 by Stanton); (3) the quantity of heat transmitted is proportional to some power of the steam velocity or mass flow ($V^{1/2}$ by Hausbrand and Ser, mass flow by Jordan); and (4) the quantity of heat transmitted is greately affected by the amount of non-condensible vapors on the steam side of the tube (Bourne, Smith, Weighton, Morrison, McBride)."

Many of the results of the earlier experimenters have been confirmed by Mr. Orrok, who has, however, carried his investigation to a conclusion much in advance of the previous work. Its scope, as he describes it, "was to determine the heat transfer through various kinds of condenser tubes and the laws governing its variation under different conditions of steam temperature, pressure and velocity; velocity of circulating water, and mean temperature difference. In order to obtain these data, a small surface condenser was constructed with a relatively small cooling surface, and it was operated under conditions as nearly like actual condenser conditions as possible. The steam inlet, dry vacuum, and circulating water lines were so arranged and controlled that any desired vacuum, any desired velocity of circulating water, and any desired mean temperature difference could be maintained and that any one of these conditions could be varied through a considerable range quite independent of the other two. A hot well was constructed and so connected to the condenser that the temperature of the hot-well water (condensed steam) and its amount could be determined. Thermometers, pressure gauges and a water meter were installed, and a record was made of all desired data." These data are given in full in Mr. Orrok's paper.

We have not space for a more detailed description of the apparatus, which is described at great length in Mr. Orrok's report, nor can we deal with the numerical results of the 770 odd tests made during the progress of the investigation. For these data, and for Mr. Orrok's graphical presentation of the results, we must refer our readers to the original paper. Here we are concerned only with his conclusions, which we reprint in full.

The first of these is that "the heat transferred from condensing steam surrounding a metallic tube to cold water flowing through the tube is proportional to the seven-eighths power of the mean temperature difference of the water and steam temperatures. This is equivalent to the statement that the coefficient of heat transfer, U, is inversely proportional to the eighth root of the mean temperature difference.

"The coefficient of heat transmission, U, is approximately proportional to the square root of the velocity of the cooling water.

"The coefficient U is independent of the vacuum and of the velocity of the steam among the tubes or in the condenser passages. It may be proportional to the square root of the velocity normal to the tubes, but in all common cases this velocity does not vary more than a tenth part.

"The effect of air on the heat transferred is very marked indeed, particularly at high vacua, and most of this air is due to leakage through the walls and joints of the apparatus. Working from Smith's curves and certain picked tests, where the volume of air could be calculated, the effect of the presence of air in reducing the value of U is as follows:

$$U = c\left(\frac{P_s}{P_t}\right)^5$$

where P_s is the partial pressure due to the steam and P_t is the total steam and air pressure.

"Taking the heat transfer of a copper tube as 1.00, under similar conditions the transfer for other materials is approximately as follows: copper, 1.00; Admiralty, 0.98; aluminium lined, 0.97; Admiralty oxidized (black), 0.92; aluminium bronze, 0.87; cupro-nickel, 0.80; tin, 0.79; Admiralty lead-lined, 0.79; zinc, 0.75; Monel metal, 0.74; Shelby steel, 0.63; old Admiralty (badly corroded) 0.55; Admiralty vulcanized inside, 0.47; glass, 0.25; Admiralty vulcanized both sides, 0.17. This coefficient (due to the material of the tube) will be designated by μ. Corrosion, oxidation, vulcanizing, pitting, etc., have also a marked effect in reducing the transfer. This reduction, best shown by the Admiralty tube which gave $\mu = 0.55$, may reduce the transfer at least 50 per cent.

"The foregoing conclusions may be expressed mathematically as follows:

$$U = K\frac{C\rho^5\mu\sqrt{V_w}}{\theta^{1/8}}$$

where C is the cleanliness coefficient varying from 1.00 to 0.5; μ, the material coefficient varying from 1.00 to 0.17; ρ, the steam richness ratio P_s/P_t, varying from 1.00 to 0; V_w, the water velocity in feet per second; θ, the mean temperature difference, and K, a constant, probably about 630. The effect of the length of tube, or rather length of water travel, has not been considered and the design of the condenser must be such that there is a free steam passage to every tube.

"This expression for U is cumbersome to use and for modern turbine condenser work certain conditions may be taken as well settled. The guaranteed vacuum is usually 28 inches. The entrance circulating water is usually 70 degrees and a 20 degree temperature rise is considered economical. Under these conditions $\theta = 18.3$ and $\theta^{1/8} = 1.44$. θ calculated on the geometrical curve is 18.2. For these cases it will be nearly as accurate and much simpler to calculate θ by the logarithmic method, neglecting θ in the denominator and using 435 or 630/1.44 for K^1. The expression will then be

$$U = K^1 C P^5 \mu\sqrt{V_w}$$

"The above equation agrees well with the results of a number of tests on full size condensers under varying conditions. There appears to have been no attempt to determine the amount of air handled by the air pump in these cases, but the amounts of air indicated by the formula are such as agree with the pressures and temperature taken."

SCIENTIFIC RAILROAD MANAGEMENT.

EFFICIENT AND ECONOMICAL MANAGEMENT AS AN ALTERNATIVE FOR RATE INCREASES AS A MEANS OF INCREASING THE NET EARNINGS OF AMERICAN RAILROADS.

Louis D. Brandeis—Hearing before the Interstate Commerce Commission.

THE sensation of the recent hearing before the Interstate Commerce Commission relative to the proposed increase of railway freight rates was the statement by Louis D. Brandeis that by the application of the principles of scientific management the operating expenses of the railroads of the United States can be reduced at least a million dollars a day. Mr. Brandeis, who represented the Traffic Committee of the Commercial Organizations of the Atlantic Seaboard, in his introductory presentation of the case for the shippers, attacked the contention of the railways that the income necessary to maintain the present dividends can be obtained only through increases of freight rates, and offered as an alternative the methods of efficient and economical management which have been successfully applied in other industries. His suggestions are discussed at some length in our editorial columns this month; below we give the principal portions of his address.

"Although the burden of proof is upon the railroads to show that the proposed increases in rates are just and reasonable, their counsel have, throughout these hearings, refrained from stating the grounds upon which they rest such contention. But the testimony introduced on behalf of the railroads shows that the contention of the railroads is substantially this:

"(1) That a greater net income is necessary in order that present dividends may be maintained, or be properly increased, and that certain additions and improvements be made from surplus income, to the end that the new capital which is required for making improvements and for increasing transportation facilities may be secured.

"(2) That this need of greater income arises from the fact that the ratio of operating expenses to gross operating revenues has risen monthly by reason mainly of the recent advances in the rate of wages, and burdens imposed through acts of Congress, such as the laws providing for safety appliances, the laws limiting the hours of labor, and the laws under which this commission has standardized railroad accounting, and required fuller reports.

"(3) That this greater net income cannot be secured otherwise than through increases in freight rates, as the possibility of economies in operation have (at least for the leading railroads) been practically exhausted.

"(4) That the proposed increases in freight rates, which are confined practically to horizontal increases of long-distance class rates, are the proper means of raising such additional net income.

"The shippers and consumers of the Atlantic seaboard take issue with the railroads on substantially each of these propositions. In the first place, we submit that even if the railroads do need additional net income, no evidence has been adduced to show that the particular increases in freight rates now under consideration are just and reasonable; and we shall offer evidence to show that the contrary is true; that the horizontal increase in class rates, as proposed, would cast new burdens, particularly upon the small producer and consumer; that it makes arbitrarily a sweeping change of long distance rates which have to a large extent been in effect for nearly a generation; changes made without evidence whether the existing rates are or are not amply compensatory; changes affecting more than 4,000 different articles made without adequate investigation into the effect upon the particular industries to which they apply; changes involving grave injustice, among other reasons, because the rates discriminate unreasonably in favor of articles to which commodity rates apply and also because they discriminate to some extent in favor of local traffic.

"We shall therefore contend that even if the railroads need additional net income, and some raise in freight rates were a proper means of securing such additional income, the commission should not approve the particular tariffs now under consideration, because the particular increases in question are not shown to be just and reasonable. In the second place, we shall offer evidence tending to show that even if the railroads need additional net income, it should be secured through greater efficiency and economy of operating instead of resorting to the dangerous expedient of raising freight rates.

"The eminent railroad presidents, who testified before your commission, have declared that further economies are practically unobtainable. To these declarations of despair, involving a vicious circle of ever-increasing freight rates and ever-increasing cost of living, we oppose the gospel of hope. As an alternative to the practice of combining to raise rates and hence to increase prices, we offer co-operation to reduce costs and hence to lower prices. This can be done through the introduction of scientific management, resulting in greater efficiency and greater economy in operation. In so saying, we offer a constructive policy of management, not personal criticism of those to whom the management of railroads is now entrusted. This greater efficiency in operation, which will follow the introduction into railroads of scientific management, must result in economies which will far more than compensate for all recent or expected increases in wages and other expenses.

"We shall show you how scientific management, when applied to the simple operation of loading a railroad car with pig iron, increased the performance of the individual worker from 12½ to 47 tons; how, when applied to shovelling coal, it doubled or trebled the performance of the shoveller. How, when applied to the operations of a machine shop, it developed, in certain operations, increases ranging from 400 to 1,800 per cent. How, when applied to brick laying, the day's accomplishment rose from 1,000 to 2,700 brick.

"We shall show that the principles of scientific management are general in their application; that they can be introduced into practically all businesses and all departments of any business; that they have been successfully applied in private competitive businesses like machine shops and factories, steel works and paper mills, cotton mills and shoe shops, in bleacheries and dye works, in printing and in bookbinding, in lithographic establishments, in the manufacture of typewriters and optical instruments, in construction and engineering works and in activities not commonly classed as business; and that recently, to some extent, they have been introduced by the United States Government into the manufacturing department of the army.

"We shall show also that, to a very slight extent, these principles of scientific management have been applied in railroading, and that, in so far as they have been so applied, they have obtained valuable results similar to those obtained in private competitive businesses.

"And, finally, we propose to show the huge field for the application of scientific management in American railroad operation and the rich fruit in economies and improved service which may be expected to result, economies which have been estimated as aggregating in amount more than a million dollars a day.

"We shall show you how railroad operation presents an especially favorable opportunity for co-operation to reduce costs through the introduction of scientific management. The fact that the railroad business is subject in its accounting to the requirements of this commission makes it possible for the commission to require that each company ascertain and report to it the simple ultimate unit cost of each operation in every department of the railroad. The further fact that the railroad business is practically non-competitive makes it proper to publish these costs and to give to each railroad the benefit of knowing the lowest elementary unit cost of each operation attained by any railroad, and how it was attained. I say ultimate unit cost, because it is necessary to obtain the ultimate unit, the cost of the molecule in the operation, before a really reliable basis of comparison can be had. The knowledge that the average annual cost of a locomotive in repairs, renewal and depreciation on one road is $3,832.37 and on another road is $2,709.27, is a very unsafe guide in determining the relative economy of operation on the two railroads. The conditions on the two railroads and standards of renewals and depreciation may vary so that the company expending the greater sum may actually have conducted its locomotive use and repairs more economically than the company expending less. What is needed as a basis of comparison is the ultimate unit cost, the cost of turning a wheel, the cost of laying a tie or a rail; and even that relatively simple operation must again be analyzed and separated into its ultimate simple elements.

"The attainment by each railroad for each operation of the lowest cost attained by any operation would not, however, satisfy the demands of scientific management. To attain only the best that has been done presents rather the beginning than the end of the economy that scientific management contemplates. With the ascertainment of the lowest existing costs the study must be made whether there is still waste time and effort involved in the best existing method of performing that particular operation, and after such waste has been determined and eliminated, there remains the wide field of research for a better way of doing the same thing. And such a system of published comparative costs would serve not only to prevent honest waste—but dishonest graft.

"Besides economies from the introduction of scientific management, there are, as we shall show you, other economies possible in railroad operation attainable under the present system of management by the introduction of new devices, like the substitution of machines for hand labor. For instance, for comparatively small capital expenditure, large economies are believed to be possible through the use of appropriate machinery in the handling of freight in loading and unloading, warehousing and accounting, thus not only reducing the terminal expense, but overcoming the congestion of the terminals, a condition constituting one of the most serious transportation problems.

"Returning now to the original contention made on behalf of the railroads, that a new source of net income through increased freight rates must be found, we submit that such need has not been shown to exist. And we propose to show that, in instances where such actual need may appear, it has resulted, not from the fact that present rates are too low, but from the fact that the management has, through reckless expansion or other waste, through financial inefficiency, impaired the financial condition of the company, and that the burden so arising should be borne by the stockholders through reduction of dividends and not by shippers and consumers through increases in freight rates."

THE ARMAMENT OF BATTLESHIPS.

A DISCUSSION OF THE RELATIVE EFFICIENCY OF VARIOUS NUMBERS AND ARRANGEMENTS OF GUNS, AND OF GUNS OF VARIOUS CALIBRES.

Sir William White—Society of Naval Architects—The Engineer.

JUST at the present moment, when the competition in naval armaments has pressed to the very utmost the output resources of the great armament firms in England, Germany, and the United States, the views of Sir William White, as they appear in an interesting paper on the subject of battleship armaments recently presented before the Society of Naval Architects and Marine Engineers, are of more than usual interest. A copy of the paper itself has not yet reached us, but an admirable discussion has appeared in the editorial columns of *The Engineer* for December 2, 1910, which we abstract at some length below. We are thus fortunately able to supplement Mr. Koon's paper on the *Dreadnought* type in this issue of THE ENGINEERING MAGAZINE with authoritative critical comment on a number of the designs he describes.

"The arguments in Sir William White's paper reflect very fairly the views of the two camps into which gunnery schools may be said to be divided. One is the all-big-gun one-calibre school, while the other advocates a secondary armament for battle purposes. As Sir William points out at the beginning of his paper, the fundamental idea which has governed the armaments of war ships in all ages is the desire to provide means of offence which will enable a ship to destroy her adversary in the shortest possible time with the minimum damage to herself, and active offence still constitutes the best, though not the only means of doing so. Sir William advocates the re-adoption of the 6-inch gun as a fighting weapon in association with not more than four twin centre-line turrets arranged as in the *South Carolina,* an arrangement which is said to be adopted in the new Japanese battleship now being built at Barrow.

"It is generally agreed that battle ranges have inevitably increased of late years, owing to the development of the locomotive torpedo, and to systems of fire control associated with improved gunnery. Conflicting views are held as to what the range will be. Climatic conditions and a serious intention of attaining a decisive issue, may tend to reduce the range that would be chosen by the faster all-big-gun ships. Herein lies the crux of the situation. When the earlier *Dreadnoughts* were built, their speed gave them the advantage of choosing the range. Now that there are numerous ships of this type, as well as much faster torpedo craft afloat, there is a strong tendency to develop the smaller weapons. But for what purpose? Not for battleship attack directly. For indirect attack, for keeping up a 'blanketing' fire, with the object of making it difficult for the enemy to see the attacking ship and on the off chance of their effecting damage to unarmoured structures and communications which influence fighting efficiency they may be useful, but it becomes a question as to whether adequate value for tonnage involved is obtained by their adoption. With records of practical experience it is impossible to reconcile Sir William White's reason for believing that actual trials do not confirm the objection to mixed armaments on the ground that the simultaneous discharge of guns of different calibres must be accompanied by diminished efficiency in the control of fire and in the proportion of hits to rounds made by guns of different calibres. We hold most strongly that in the *King Edward* class, for instance, the accuracy of 6-inch fire is materially affected by the simultaneous discharge of the 9.2-inch and 12-inch guns. It suffers also in rapidity from the smoke nuisance.

"In referring to the number of heavy guns to be mounted, Sir William advocates pairs, and goes on to note the extraordinary Italian practice of mounting three triple and two twin turrets in the *Dante Alighieri* class. Triple turrets involve insuperable objections to practical gunners of the 'hit-the-target' order; beside being too many eggs in one basket they suffer from smoke interference and 'throw-off' to an excessive extent. The relationship of protective material and the adequate support of the same also receives attention. In many foreign vessels we find turret roller paths fixed directly to or supported on the vertical barbette armour—a most dangerous practice, as in action the combined efficiency of the heavy gun armament, in spite of heavy blows on the protective armor, is a primary consideration. Adequate clearance between fixed and moving portions of a turret should always be allowed in spite of the increased overall dimensions and weight necessary. Reference is made to the maximum number of heavy guns that should be carried by a warship. Here the author is on much safer ground. In tonnage value for effect obtainable, it is hard to believe that it is possible to improve on the arrangement, first adopted in the United States battleship *Michigan,* of four twin turrets on the centre line, the two inner turrets firing over the two end turrets. Such an arrangement possesses the great advantage of minimum interference between turrets due to 'blast.' The system adopted in the *Inflexible* class, in the *Von der Tann* or the Spanish battleships, of having two centre line and two echelon turrets, really reduces these vessels in practice to the status—considering broadside work only—of six-gun ships. On paper, the echelon arrangement allows three pairs of turrets to fire ahead and astern on the keel line. On board, such a discharge causes unpleasant consequences, and the limits of safe training in practice are considerably less than the extremes shown on the drawings. Of course, automatic danger signals—generally shrill buzzers by the side of the turret training levers—are supplied to warn the gun-layer when he risks his own or his neighbor's comfort from blast, but these are extremely apt to be unreliable in action, and the system of mounting guns to avoid this, even if the number of heavy guns be reduced, will probably be found best in service. The advantage conferred by confining the primary armament to the ends of a ship, as far as magazine accommodation is concerned, is very considerable. Side turrets, as in the *Dreadnought* or *Minas Geraes,* are inconvenient—the *Nassau* is very bad with four large turrets crowded together—owing to the difficulty experienced of making a good boiler and engine-room arrangement. Sir William White does not touch on the point beyond referring to the objection of mixing stokeholds and magazines, but it entails probably an additional row of boilers to make up for the staggered units cut out by an echelon arrangement, or an increased length over the machinery space to allow for a transverse magazine. This involves a corresponding addition to the length, weight, and cost of the heavy belt armor. In view of this and the question of interference, his deliberately expressed convictions that in no case is it desirable to mount more than eight heavy guns in a single ship, and that these are best arranged in four positions, as in the *Michi-*

gan class, will meet with less criticism than his third view that they should be supplemented by a powerful and well protected secondary armament. A large number of naval officers want a protected 6-inch battery reintroduced, in spite of their expressed conviction that its fire may be discounted at ordinary battle ranges when acompanied by a 12-inch gun fire. Here is where Sir William White takes an opposite view. A secondary battery mounted as in the *Michigan* on the upper deck is, in our opinion, vastly better than the corresponding main deck battery of the *Delaware.* With, however, the smoke nuisance from the heavy guns, the continual anticipation of blast effect from overhead, and the lower rate of fire inevitable from these causes, as well as from the desire for accuracy, it is hard to agree with him. The naval desire for the reintroduction of the 6-inch gun arises from a belief that it is a better anti-torpedo gun than the 4-inch. Opinions on this point also differ widely. If the increased calibre of heavy guns tends to put up battle ranges, then it probably is; but the 4-inch should also be retained, in our opinion, for mounting in the superstructure.

"At the conclusion of his paper Sir William White turns to the important point of future gun calibre, and draws a trenchant parallel between present practice and that of twenty years ago. All the arguments that held good for the increase from 12-inch to 13.5-inch hold good for an early advance to 15-inch or 16-inch. Such a gun is being made, we believe, at the presnt time. No argument is raised against such a calibre, except that of larger or more costly ships. This has never been heeded. Warships of all kinds are generally smaller than merchant vessels, and for many years the largest have never exceeded about 60 per cent. of the greatest mercantile displacement. There are at present at least four ships being built with over 60,000 tons full load displacement, and an increase in warship size is inevitable in the early future. So it is with speed. The *Von der Tann* and *Lion* will set examples of a far-reaching kind. Nothing is said of the tactical influence of speed or armament in the paper under review, but it is obviously considerable. Meanwhile, in spite of Sir William White's generous treatment of the subject, we feel assured that the big-gun school, adhering to the results of their practical experience, will remain unconvinced that for fighting purposes anything less than the biggest convenient gun is worth having."

THE PREVENTION OF COAL DUST EXPLOSIONS.

A REVIEW OF THE FACTORS AFFECTING EXPLOSIBILITY, THE CONDITIONS AFFECTING PROPAGATION OF EXPLOSIONS, AND REMEDIES FOR COAL DUST.

George S. Rice—United States Geological Survey.

A MONOGRAPH of nearly two hundred pages bearing the title, "The Explosibility of Coal Dust," recently issued as Bulletin 425 of the United States Geological Survey, gives an exhaustive treatment of the theory and prevention of coal-dust explosions, taking into account the results of investigations in various countries and the literature of the subject up to the end of 1909. More than half of the Bulletin is the work of George S. Rice; the remainder comprises special contributions by J. C. W. Fraser, on laboratory investigations of the ignition of dust in Europe and the United States; by Axel Larsen, who reviews the coal-dust investigations at European testing stations; by Frank Haas, who discusses the use of exhaust steam as a preventive of dust explosions; and by Carl Scholz, on the use of steam and water sprays in Oklahoma mines. The main topics dealt with by Mr. Rice include an historical review of the coal-dust question in Europe and the United States, the origin and distribution of coal dust, preliminary experiments with explosible dusts at the Pittsburg testing station, the humidity of mine air, and the various remedies for coal dust which have been proposed and put in practice. The present review is concerned only with the tentative conclusions offered by Mr. Rice as to the factors affecting explosibility, the conditions affecting propagation of explosions, and the advantages and disadvantages of the proposed remedies.

"The outward circumstances under which coal dust will explode may be summed up as follows: Sufficient dust must be brought into suspension by a preliminary shock or concussion producing a violent air wave; or else the dust must be so minute that it is already suspended in a dense enough cloud at the moment when the flame impinges. The latter effect is produced only under some peculiar circumstances by which a large amount of fine coal dust is thrown into a strong air current and carried to the igniting flame. The former effect may be produced by a heavy shock like that from a falling body, but is much more likely to result from a preliminary explosion of firedamp or, more commonly, of an explosive.

"The weight of coal dust that must be thrown into suspension to permit propagation of an explosion depends on (*a*) the percentage of volatile combustible constituents; (*b*) the amount of contained and adhering moisture; (*c*) the presence of foreign substances like stone dust; and (*d*) the size of the dust particles, the effect of which is twofold—the smaller the particles the more easily the air concussion can raise them, and the more surface is exposed for the evolution of gas.

"The minimum density of the dust cloud necessary to propagate an explosion evidently varies with the initial cause as well as with the character of the dust. Using 190-mesh bituminous dust, M. Taffanel obtained explosions regularly with a density of 70 grams per cubic metre (0.07 ounce per cubic foot), and in one instance obtained propagation with as low a density as 23 grams per cubic metre (0.023 ounce per cubic foot). In the experiments at the Pittsburg station with 200-mesh dust from the Pittsburg coal seam, in a much larger gallery, but also with far larger charges of explosive, two propagations were obtained with as low a dust density as 32 grams per cubic metre (0.032 ounce per cubic foot). Density tests with the coarser sizes have not yet been made in the Pittsburg station.

"The experiments with wetted dust at the Pittsburg station have been very instructive. Where there is a large amount of dry coal dust, judging from the Pittsburg experiments, a humid atmosphere has little effect on ignition of dust or propagation of an explosion. A long continuance of the humid conditions renders the coal dust moist and inert, but the presence of moisture in the air at the moment of explosion is not sufficient to prevent an explosion; that is, not enough moisture is carried by the mine air to reduce materially the temperature of the flame." The weight of vapor in fully saturated mine air at ordinary mine temperature, say 65 degrees F., carrying coal dust in suspension in a cloud of moderate density, say 200 grams per cubic metre, is but 7.8 per cent. of the weight of the dust. "The Pittsburg experiments with wetted dust showed that several times this percentage of moisture in the dust, in addition to a nearly saturated atmosphere, was required to prevent propagation. Probably with a low dust density the relative humidity of the air would be an important factor in tending to prevent the initiation of an explosion. However, *the great purpose of artificially humidifying mine air is that it may serve as a vehicle for carrying water to the dust.*

"When the dust is abundant, the effect of high ash content, unless that content is excessive, is apparently not noticeable. The upper limit has not yet been closely defined by experiment. The effect of intimately mixing coal dust with shale dust or stone dust has also not been fully determined experimentally. The few tests in this direction conducted at the Pittsburg station have been with 'road dusts' or other coarse mixtures, and the tests with these indicate that the amount of the inert substance has to be very large, possibly equal to the amount of pure coal dust. The tests with finely pulverized stone dust in the Altofts experiments have been directed to supplanting or covering up coal dust in certain zones, but not to mixing stone dust with the coal dust."

The methods put forward for the prevention of coal-dust explosions may be divided into two classes. The object of the methods of the first class is to render the dust inert; of the second class, to prevent explosions from blown-out shots and to limit initial explosions. In the first class six methods may be noted: (1) Loading and cleaning up dust; (2) sprinkling from water cars; (3) application of calcium chloride and other deliquescent salts; (4) sprinkling and washing down with hose and nozzle; (5) the use of pipe lines and permanent sprinklers; and (6) humidifying the intake air current by steam sprays. The second class comprises three methods: (1) the use of quick-flaming or short-flaming ("permissible") explosives; (2) coating the walls and floor of the passageways with rock dust, either wholly or in zones; and (3) limiting the extent of explosions by the construction of brick or concrete linings of definite length and intervals and keeping them perfectly clean.

Dealing with these nine methods in order, "cleaning up coal dust and sending it out of the mine is a plan used more or less under all systems, but applied only to large masses of dust. The plan cannot reduce the quantity below the danger point." Sprinkling the roadway by means of water cars was the earliest method employed for watering coal dust. "Water cars with force sprinklers, in which the pressure is produced by pump or air pressure, if used frequently and thoroughly, are good. The great danger is that they will not be so used throughout all the mine, owing to their interference with the haulage of coal, and frequently owing to the lack of tracks in the air course or manways. When used intermittently the water-car system is useless because the dust is not wetted; as the drops of water do not mix with it, they are exposed to the air currents and quickly dry up."

The use of hygroscopic or normally deliquescent materials, such as calcium chloride and similar salts, to promote the retention of water by coal dust was suggested as early as 1879, but attracted little attention until the last few years. The method "has not yet been sufficiently tested to permit a conclusion as to its effectiveness in preventing explosions. If it renders the dust merely dampish—that is, not sufficiently moist to prevent explosions—it may improve the sanitary condition and lessen the quantity of float dust. It may also prove to be effective in supplementing intermittent sprinkling, enabling the dust to absorb drops of water that would otherwise be taken up by the air current.

"Thorough washing down of roof and walls with hose is required by the mining laws in Germany, and in this country in Utah. If thoroughly and frequently done it is undoubtedly most effective. The difficulty is that usually it is not done systematically and thoroughly. It is a system that cannot be effectively applied to shaly or weak roofs without resulting in many falls and great cost of timbering.

"Using permanently located sprinklers, attached to pipe lines and running continuously, but with a flow that can be varied according to need, is very effective in saturating the mine air within a moderate distance of each sprinkler, and through this means gradually wetting the dust. One of the great merits of the system is that the sprinklers can be distributed where most needed; that is, where there is a tendency to produce the most dust or where the humidity of the air current is lower than it should be. A disadvantage in some mines is that the moisture causes falls of roof. Where there is roof material that will come down, or fire-clay floor that will swell immediately on contact with water, in order to use sprinklers it may be necessary to introduce brick or arched linings, sometimes with concrete floor and sump, and to place individual sprinklers in the lined sections. The linings would serve two purposes—to catch any condensed water from the sprays and to provide a damp and dust-free zone, limiting a possible dust explosion from either side. The use of more complete zonal linings is well worthy of consideration for long-lived mines or long-lived entries (particularly the main entries), not alone as a dust remedy, but also for fire protection."

The use of exhaust-steam sprays is treated extensively in the Bulletin by Frank Haas and Carl Scholz. Here, however, we give in abstract only Mr. Rice's estimate of their value. "Humidifying the intake air current with exhaust-steam sprays is much the easiest and cheapest method of introducing moisture into a mine where the ventilating fan is run by a steam engine. The quantity of steam that it is necessary to use in the fan engine for ordinary air-ventilating pressures is sufficient to humidify the air in moderately cold weather, but in extreme cold weather is insufficient. Therefore it must be supplemented by live steam, or, as suggested by Mr. Frank Haas, in order to insure that it is used, by passing more steam through the engine. The same result could be accomplished by passing the steam through a registering meter."

The disadvantage of steam sprays is the fogging of the air current in cold weather, which causes conditions of discomfort and danger in the haulage ways. A blowing system of ventilation, utilizing the haulage way for the return air and placing the steam sprays on the air way at the intake, obviates this difficulty, but manifestly it cannot be safely used in gassy mines or in mines liable to an outburst of gas, particularly when electric haulage is employed. In such mines the only alternative is to have an additional entry for the return air, making the ventilation in the haulage way "neutral," or passing through it a very small supply of fresh air, an impossible condition in most old mines. The decision as to the use of the steam-spray system must depend on whether the mine makes sufficient gas to prevent the return air being passed through the haulage way. A compromise method is to use steam sprays in the haulage way at night only, water sprays being used only on the day shift when haulage is in progress.

The opinion is widely held that the use of exhaust steam for humidifying would be especially severe on the roof. This is not generally true. "The condition of humidity obtained by its use is very uniform. Where humidifying is not done it is the alternate drying out and wetting due to the changes in weather that causes most of the trouble. The roof is not subjected to any more severe conditions by steam or water sprays than in spring, when hot, moist air enters the mine. Later in the summer during the hot weather the same degree of moisture prevails, but the roof, becoming acclimated, as it were, to this condition, is not as likely to fall as during the spring, when the change of temperature and humidity took place. If, when cold weather comes, the humid condition of summer is maintained by introducing sprays, the roof will not be subject to violent changes in humidity.

"The use of stone dust is the most recent suggestion for either preventing or limiting explosions of coal dust. As the method is only in the experimental state, it is too early to express any decided opinion. The results at Altofts appear very favorable. Not all the mines in this country provide a suitable stone for grinding, but burned dirt piles or clay or sand are nearly always available, and to a limited extent, thoroughly burned ashes from the boiler plant. The method is not so adaptable to room and pillar workings as to the long-wall system, but it may prove a valuable alternative remedy for coal dust where the humidifying methods are considered inapplicable on account of danger to the roof, or in those mines in the arid parts of America where water for humidifying is not available.

"If in addition to wetting coal dust throughout a mine by one of the foregoing methods, 'permissible' explosives are used for shooting coal at the face, or for brushing or grading the roadways, the chances of starting a wide-sweeping mine explosion are reduced to a minimum. As a means of prevention of dust explosions, the writer would place the employment of permissibles at the head"

THE ENGINEERING INDEX

"THE KEYSTONE IN·THE·ARCH·OF·APPLIED·SCIENCE."

The following pages form a *descriptive* index to the leading and special articles of permanent value published currently in the Transactions of all the important engineering societies of both Europe and America, and in all the leading engineering journals of the world—in the English, French, German, Dutch, Italian, and Spanish languages.

The term *descriptive* is used because the definite purpose of each index note is to indicate clearly the character and purpose of the article or paper described; and with that in view we give the following essential information about every publication:

(1) The title of the article,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published,
(7) *We supply the article itself, if desired.*

☞ The full text of every article described in the Index, together with all its illustrations, can usually be supplied by us.—See the "Explanatory Note" at the end of the Index, where also the full titles of the principal journals indexed are given.

NOTE—The busy engineer will also observe that the Index is conveniently classified into the larger divisions of engineering science, to the end that the reader may quickly turn to what concerns himself and his special branches of work. By this means it is possible, within a few minutes' time each month, to learn promptly of every important article published anywhere in the world, in any language, upon the subjects claiming one's special interest.

DIVISIONS OF THE ENGINEERING INDEX.

CIVIL ENGINEERING	Page 631	MECHANICAL ENGINEERING	Page 647
ELECTRICAL ENGINEERING	" 639	MINING AND METALLURGY	" 659
INDUSTRIAL ECONOMY	" 645	RAILWAY ENGINEERING	" 666
MARINE AND NAVAL ENGINEERING	" 646	STREET AND ELECTRIC RAILWAYS	" 669

CIVIL ENGINEERING.

BRIDGES.

Bascule.

Construction of the Kinzie St. Drawbridge (Chicago) and Its Deep Foundations: Chicago & Northwestern Ry. W. H. Finley. Description of methods adopted in constructing this bascule bridge over the Chicago river. Ills. 3500 w. Eng News—Nov. 24, 1910. No. 18873.

Erection.

Cribbing for Small Spans from the Top of Piers. A. van der Meersch. Illustrates and describes methods adopted on work in West Africa. 600 w. Engr, Lond—Oct. 21, 1910. No. 18302 A.

Piers.

The Beaver Bridge Piers. Illustrated description of piers for the double-track cantilever bridge over the Ohio River at Beaver, Penn. 2000 w. Eng Rec—Nov. 19, 1910. No. 18663.

Quebec.

The Removal of the Debris of the Old Quebec Bridge. H. P. Borden. Illustrated description of methods of cutting apart by the use of oxy-acetylene, and of dynamite. 1600 w. Eng News—Nov. 10, 1910. No. 18453.

The Removal of the Debris of the Old Quebec Bridge. Gives illustrations showing the work at various stages, with descriptive notes. 1800 w. Engr, Lond—Nov. 18, 1910. No. 18995 A.

Tests of Nickel-Steel Models of Compression Members in the Official Design of the New Quebec Bridge. Illustrated detailed description of tests, with editorial comment. 6000 w. Eng Rec—Nov. 19, 1910. No. 18660.

Reconstruction.

Reconstruction of the Steubenville Bridge. Illustrated description of the replacing of the steel superstructure in an unusual way without interrupting traffic. Also editorial. 5000 w. Eng Rec— Nov. 26, 1910. No. 18951.

Reinforced Concrete.

The Stadhouder Bridge, at the Hague (De Stadhoudersbrug te 's Gravenhage). Y. M. D. Kentie. A detailed description of the design and construction of a reinforced-concrete arch highway bridge of 24 metres span. Ils. 9000 w. De Ingenieur—Oct. 29, 1910. No. 18936 D.

The Replacement of the Reichsstrasse Bridge over the Passer in Meran (Der Umbau der Reichsstrassenbrücke über die Passer in Meran). Rudolph von Hartlieb. Describes the erection of a concrete-arch highway bridge, replacing a steel truss. Ils. 2500 w. Oest Wochenschr f d Oeffent Baudienst—Oct. 1, 1910. No. 18788D.

See also Steel, and Trestles, under BRIDGES.

Steel.

The Walpole Bridge. Illustrated description of a highway bridge across the Connecticut River, having unusual lengths for plate girder spans, and other interesting features. 1200 w. Eng Rec—Nov. 12, 1910. No. 18511.

Steel-Concrete Arch Bridge. Illustrated description of a recently completed structure in Syracuse, N. Y. Steel arches enclosed in concrete, supporting reinforced-concrete floor slabs. 1200 w. Munic Jour & Engr—Nov. 2, 1910. No. 18356.

See also Reconstruction, under BRIDGES.

Trestles.

Converting a Steel Trestle Into a Reinforced-Concrete Trestle. Illustrated description of work on the Wabash Ry. near St. Charles, Mo. 1000 w. Eng News—Nov. 10, 1910. No. 18450.

Reinforced Concrete Trestles for Railways. C. H. Cartlidge. Illustrates and describes structures devised to replace timber or wooden pile trestles for shallow openings. Discussion. 9800 w. Jour W Soc of Engrs—Oct., 1910. No. 18830 D.

Viaducts.

Reinforcement of the Pecos River Viaduct: Southern Pacific Ry. Illustrates and describes particulars of the recent reinforcement of this structcre on the So. Pacific Ry., in Texas. 1700 w. Eng News—Nov. 3, 1910. No. 18347.

CONSTRUCTION.

Concrete.

Tests to Determine the Effects of Frost on Concrete and Methods of Concrete Work in Freezing Weather. J. H. Chubb. Shows that winter work cannot be handled the same as summer work, but with proper precautions can be safely carried on. 3000 w. Engng Con—Nov. 23, 1910. No. 18887.

Forms for Concrete. J. D. Stevenson. Deals particularly with forms used in concrete construction, especially the filtered water reservoir of the Pittsburgh Filtration Works. Discussion of this paper includes F. E. Field's paper. Ills. 12000 w. Pro Engrs' Soc of W Penn—Oct., 1910. No. 18822 D.

See also Excavation, under CONSTRUCTION.

Contractors' Plants.

Contractors' Plants—Types, Layout and Methods of Operation. Frederick E. Field. Introductory remarks with a consideration of the layout of plant and methods of operation in several parts of the work of construction of the filtration works of the City of Pittsburgh. Ills. 7800 w. Pro Engrs' Soc of W Penn—Oct., 1910. No. 18821 D.

See also Concrete, under CONSTRUCTION.

Earth Pressures.

Earth Pressures in Rock Tunnels. (Ueber die Zerstörungen in tunnelartig gelochten Gesteinen). A. Leon and F. Willheim. A study of stress distribution in the walls of tunnels by means of tests of rocks pierced with holes similar in shape to tunnel sections. Ills. 4000 w. Oest Wochenschr f d Oeffent Baudienst —Oct. 29, 1910. No. 18790 D.

Excavating Machinery.

English Navvies and American Steam Shovels. A. F. Dickinson. An illustrated comparative study of excavating machines. 2200 w. Cassier's Mag—Nov., 1910. No. 18611 B.

See also Shovels, under ELECTRICAL ENGINEERING, POWER APPLICATION.

Excavation.

New Rules of Measurement for Excavation and Concrete Work in Chicago. Rules of interest to contractors, reprinted from the 1910 Guide of the Masons and Contractors' Assn. 2000 w. Engng Con—Nov. 16, 1910. No. 18592.

Methods of Excavating Canal Prism, Using a Bridge Conveyor Excavator, with Costs of Work for Twenty-four Consecutive Months. Illustrated account of work on Contract 6 of the N. Y. State Barge Canal. 1800 w. Engng-Con—Nov. 23, 1910. No. 18888.

Fireproof.

Examples of Simple and Efficient Cement and Steel Fireproof Construction. H. M. Naugle. Illustrates and describes a system in which the frame of the structure is made to serve as a combined form and reinforcement. 1200 w. Cement Age—Nov., 1910. No. 18621.

Fireproof Walls in Reinforced Concrete (Feuersichere Wände aus Eisenbeton). R. Saliger. A discussion of the fire-resisting properties of concrete and of wall design in fireproof structures. 2600 w. Beton u Eisen—Oct. 27, 1910. No. 18797 F.

See also Regulations, under CONSTRUCTION.

Foundations.

Foundations of the Municipal Building, New York City. Illustrated detailed descriptions of the important and remarkable foundations for a 25-story-and-tower steel-frame office building, explaining conditions and work. 6000 w. Eng News—Nov. 17, 1910. No. 18605.

Completion of Foundations for the Municipal Building, New York. Illustrated description of unusual caisson work Also editorial. 3500 w. Eng Rec—Nov. 5, 1910. No. 18407.

Gas Holders.

Brick, Concrete and Steel Holder Tanks. Herbert W. Alrich. Read before the Am. Gas Inst. Discusses in detail tanks above and below ground, and brick, concrete and steel as materials, favoring steel tanks above ground. Ills. 11700 w. Am Gas Lgt Jour—Nov. 14, 1910. No. 18517.

Gas Holders (Gasaufspeicherung). Herr Scheuss. A review of German practice in the design and construction of gas holders. 3200 w. Zeitschr d Ver Deutscher Ing—Oct. 1, 1910. No. 18919 D.

Piling.

The Steel Sheet Pile in the South. J. F. Springer Brief review of the development, and illustrated description of applications. 4000 w. Mfrs' Rec—Nov. 3, 1910. No. 18345.

The Making, Driving and Jetting of Reinforced Concrete Piles. Frank B. Gilbreth. Illustrates and describes methods used. Also general discussion. 15000 w. Jour Am Soc of Engng Con—June, 1910. No. 18309 N.

The Konus Concrete Pile (Der Konus-Betonpfahl). W. Siegfried. A detailed description of a new system of pile foundation. Ills. 4000 w. Schweiz Bau—Oct. 29, 1910. No. 18772 B.

Regulations.

Building Regulations and Fire Insurance (Bouwverordening en Brandgevaar in Verband met Brandverzekering). W. H. A. Elink Schuurman and W. Meijer Cluwen. A discussion of the technical aspects of fire-insurance rating. Ills. 10800 w. De Ingenieur—Oct. 22, 1910. No. 18935 D.

Reinforced Concrete.

Methods of Computing Reinforced Concrete Flat Slabs. Louis F. Brayton. Read before the Nat. Cement Users Assn. States the views of the author in regard to the form the surface takes, and explains methods of calculation. 2500 w. Engng-Con—Nov. 2, 1910. No. 18337.

The Design of Reinforced-Concrete Slabs for Uniformly Distributed Loads (Berechnung vierseitig freiaufliegender rechteckiger Platten mit gleichmässig verteilter Belastung). J. N. Dorner. Mathematical. Ills. 2900 w. Beton u Eisen—Oct. 27, 1910. No. 18799 F.

A Reinforced-Concrete Cold Storage Warehouse at Jersey City, N. J. Arthur G. Hoadley. Illustrated description of a recently completed adidtion to the plant of the Union Terminal Cold Storage Co. 1500 w. Eng News—Nov. 3, 1910. No. 18351.

The Maverick Cotton Mills at East Boston. Illustrated description of reinforced concrete textile mills of large size, now under construction. 1600 w. Eng Rec—Nov. 5, 1910. No. 18408.

See also Fireproof, Piling, Retaining Walls and Steel, under CONSTRUCTION; Reinforced Concrete, under MATERIALS OF CONSTRUCTION; Dams, under WATER SUPPLY; Wharves, under WATERWAYS AND HARBORS; and Poles, under ELECTRICAL ENGINEERING, TRANSMISSION.

Retaining Walls.

The Design of Retaining Walls, Adapted from George Christoph Mehrtens, "Vorlesungen Ueber Static der Baukonstructionen und Festigkeitslehre." George M. Purver. Mathematical demonstration. 3500 w. Engng-Con—Nov. 2, 1910. No. 18339.

Recent Retaining Wall Practice, City of Pittsburgh. Charles M. Reppert. Reviews the methods used in the design and construction of these works, giving cost data. Ills. 13500 w. Pro Engrs' Soc of W Penn—Oct., 1910. No. 18823 D.

Enlargement of the Track Space at the Saint Lazare Station, Paris (L'Elargissement du Goulot de Saint-Lazare, à Paris). Charles Rabut. Describes the construction of a reinforced-concrete retaining wall with hanging sidewalk which gives more tracking space. Ills. Serial, 1st part. 4200 w. Génie Civil—Oct. 1, 1910. No. 18718 D.

Steel.

Structural Steel Details of the Curtis Building. Details of girders, trusses, and various connections of a 12-story steel cage building in Philadelphia, are illustrated and described. 3500 w. Eng Rec—Nov. 5, 1910. No. 18405.

Packard Motor Car Company's Service Building, Queensboro, New York City. Illustrated detailed description of an 8-story building of steel and reinforced-concrete. 1400 w. Horseless Age—Nov. 16, 1910. No. 18670.

Permissible Stresses in Steel for Buildings and Bridges (Ueber zulässige Spannungen im Eisen, im Hoch- und Brückenbau). A discussion of modern practice in designing steel members. Ills. 5400 w. Beton u Eisen—Oct. 7, 1910. No. 18796 F.

Tunnels.

Excavation of the Wallkill Pressure Tunnel—Catskill Water Supply to New York City. Illustrated description of methods of rock tunnel driving. 2500 w. Engng-Con—Nov. 9, 1910. No. 18442.

Driving Spiral Tunnels on the Canadian Pacific Ry. The method of tunnel driving is illustrated and described. The two spiral tunnels between Field and Hector, B. C. 2500 w. Eng. News—Nov. 10, 1910. No. 18454.

See also Earth Pressures, under CONSTRUCTION.

MATERIALS OF CONSTRUCTION.

Brick.

Causes of and Methods of Preventing Efflorescence on Brickwork. From a paper by A. F. Graves-Walker. 1500 w. Engng-Con—Nov. 23, 1910. No. 18891.

Cement.

The Use of Cement and Its Substitutions. Ernest McCullough. Information concerning these materials. 2000 w. Min Wld—Nov. 12, 1910. No. 18545.

Concrete.

See same title, under CONSTRUCTION.

Lead.

The Art and History of British Leadwork. Lawrence Weaver. An illustrated lecture on the history of leadwork and its uses, especially in architecture. 4500 w. Jour Soc of Arts—Nov. 4, 1910. Serial. 1st part. No. 18549 A.

Paints.

The Permeability of Paint Films. Henry A. Gardner. Gives results of a series of tests made to determine the water excluding value of various pigments. 500 w. Jour Fr Inst—Nov., 1910. No. 18698 D.

Alternatives to the Use of White Lead. Noel Heaton. Read before the Nat. Assn. of Master Decorators, at Newcastle. Examines the claims of other white pigments as compared with white lead. 3500 w. Archt, Lond—Nov. 4, 1910. Serial, 1st part. No. 18553 A.

Reinforced Concrete.

Investigations on the Slip of Rods Imbedded in Concrete. H. Burchartz. Reports results of tests made by Dr. Ing. E. Preuss, and states the conclusions drawn. 1200 w. Eng Rec—Nov. 12, 1910. No. 18512.

Ferro-Concrete. Editorial review of the interim report of the committee appointed by the Inst. of Civil Engrs. 2000 w. Engng—Oct. 28, 1910. No. 18498 A.

Reinforced Concrete (Gewapend Beton). S. G. Everts. A review of the development of this material, with some notes on modern practice. Ills. 5400 w. De Ingenieur—Oct. 15, 1910. No. 18934 D.

Timber.

Air Circulation in Lumber Driers. Information concerning drying methods and driers. 2800 w. Wood Craft—Nov., 1910. No. 18346.

The Commercial Hickories. Anton T. Boisen and J. A. Newlin. Discusses their economic importance, the supply, lumbering, mechanical properties, &c. Ills. 18000 w. U. S. Dept of Agri, Bul 80—1910. No. 18310 N.

Timber Preservation.

Some Notes on Methods and Costs of Chemically Treating Cross Ties. Gives results of studies made in connection with track reconstruction of Chicago street railways. 4500 w. Engng-Con—Nov. 23, 1910. No. 18890.

Creosoting Plant of the Pacific Creosoting Co., Eagle Harbor, Washington. General view and description of the plant, with specifications for creosoting piling. 1500 w. Eng News—Nov. 3, 1910. No. 18348.

MEASUREMENT.

Astronomical Observations.

Method of Determining the Meridian from a Circumpolar Star at Any Hour. Eugene R. Rice. Describes a method needing only one observation, and from it azimuth, latitude and sidereal time are computed. 2500 w. Brit Am Inst of Min Engrs—Nov., 1910. No. 18838 F.

Leveling.

Precise Leveling in the Southwest. Henry W. Maynard. Describes difficulties met and the manner in which the regular method of leveling was adapted to the conditions. 2500 w. Cornell Civ Engr—Nov., 1910. No. 18829 C.

Paving-Brick Testing.

Rattler Test for Paving Bricks. Describes investigations in progress to eliminate defects in this test. Ills. 2000 w. Munic Jour & Engr—Nov. 16, 1910. Serial, 1st part. No. 18591.

Stream Gauging.

Stream Measurements for the Dominion Government in Alberta, Sask. Abbreviated from report by Mr. Sauder. Illustrates and describes the hydrographic work of the Government. 3500 w. Can Engr—Nov. 3, 1910. Serial. 1st part. No. 18387.

Surveying.

Insurance Surveying and Map Making. R. P. Getty. Information concerning the making of the records of municipal fire risks. 8500 w. Cassier's Mag—Nov., 1910. No. 18612 B.

See also Leveling, under MEASUREMENT; and Photography, under MECHANICAL ENGINEERING, MACHINE ELEMENTS AND DESIGN.

MUNICIPAL.

Accounting.

Municipal Accounts. Richard M. Chapman. Explains the principal characteristics of public accounts, the difference between fund accounts and cash accounts, and matters relating to this subject. 4000 w. Jour of Acc—Nov., 1910. No. 18548 C.

American Cities.

American City Growth: Causes and Effects. Richard H Edmonds. Address before the Phila. Chap. of the Am. Inst. of Banking. Discusses the economic cause and effect of the great increase in urban population. 4000 w. Mfrs' Rec—Nov. 10, 1910. No. 18421.

City Planning.

City Design and Transportation. Gives abstracts of opinions of M. Wattmann, as expressed in a paper read before the Int. St. and Interurban Ry. Assn. at Brussels. 2000 w. Eng Rec—Nov. 19, 1910. No. 18661.

Drainage.

A Velocity-Reducing Drainage Outfall. Illustrates and describes levees, ditches and conduits designed to prevent flooding near Summit, Illinois. 1200 w. Eng Rec—Nov. 12, 1910. No. 18515.

Industrial Wastes.

The Sewerage Question and Treatment of Trade Effluents. John D. Watson. Read before the Com. of Engrs. & Surv. Discusses conditions in England, the laws and need of action. 2500 w. Plumb & Dec—Nov. 1, 1910. No. 18554 A.

The Disposal of Cheese Factory Waste. From the annual report of the Ontario Provincial Board of Health for 1909. Discusses the problems involved and gives descriptions of two plants. 3300 w. Can Engr—Nov. 3, 1910. No. 18386.

Pavements.

Bituminous Pavements. Patented and Otherwise. E. A. Kingsley. Read before the Am. Soc. of Munic. Imp. Remarks on the early use of this material and the modern pavements. Also reply by George C. Warren. Ills. 3500 w. Munic Engng—Nov., 1910. No. 18808 C.

Asphalt-Pavement Specifications. Report of recommendations by the Committee of the Am. Soc. of Munic. Imp. 5000 w. Munic Jour & Engr—Nov. 2, 1910. No. 18357.

Close Jointed Heavily Grouted Granite Block Pavement. A report of work at Newark, N. J., with extracts from specifications. 2800 w. Engng-Con—Nov. 16, 1910. No. 18593.

Pavements of Erie, Pa. Faulkner G. Lynch. Read before the Am. Soc. of Munic. Imp. Information concerning the kinds of pavement, the cost, maintenance, &c. 1800 w. Munic Engng—Nov., 1910. No. 18809 C.

See also Paving-Brick Testing, under MEASUREMENT.

Public Baths.

See also Plumbing, under MECHANICAL ENGINEERING, HEATING AND COOLING.

Refuse Disposal.

The First Garbage Reduction Works Built by an American City; Columbus, Ohio. Illustrated detailed description of the plant and its equipment. 3500 w. Eng News—Nov. 17, 1910. No. 18609.

The Columbus Municipal Garbage Reduction Plant. Irwin S. Osborn. The plant and its equipment are illustrated and described in detail. 3500 w. Eng Rec—Nov. 19, 1910. No. 18664.

Milwaukee Garbage Destructor. Illustrated description of one of the latest plants, in which the garbage is incinerated without the aid of fuel other than that found in the refuse. 1500 w. Power—Nov. 29, 1910. No. 18966.

New Refuse Destructor and Sewage Ejector Works in Guildford. C. G. Mason. Read before the Inst. of Munic. & Co. Engrs. Illustrates and describes the buildings and their equipment. 4000 w. Surveyor—Oct. 21, 1910. No. 18289 A.

Roads.

Experiments in Binding Gravel and Crushed Gravel with Tar and Asphalt and in Constructing a Water Bound Road of Gravel. A report of experimental roads constructed by the Ohio Highway Department. 2500 w. Engng-Con—Nov. 2, 1910. No. 18338.

Testing Materials for Use on Highway Construction. A. F. Armstrong. Describes laboratory tests for the different materials used to secure the better grades. 5000 w. Cornell Civ Eng—Oct., 1910. No. 18274 C.

Tests of Various Road Surfacing Materials by the Ohio State Highway Department. Describes the test road for determining the wearing qualities of the various patented preparations for surfacing macadam roads. 6000 w. Eng News—Nov. 10, 1910. No. 18451.

Notes on Road Construction. W. Calder. Read before the Melbourne Univ. Engng. Soc. Information concerning methods employed in the Prahran Municipality and results of the writer's experience. Ills. 9500 w. Surveyor—Nov. 18, 1910. No. 18983 A.

Highway Dust Reduction in the Urban District of Alton. G. Bertram Hartfree.

Read before the Inst. of Munic. & Co. Engrs Reviews the various experiments made to allay dust, their results and cost. 4500 w. Surveyor—Oct. 28, 1910. No. 18489 A.

Country Roads. R. J. Harding. Brief discussion of the change in methods made necessary, and the organization and management of the State highways of New York. Ills. 1000 w. Cornell Civ Eng—Oct., 1910. No. 18275 C.

A Few Facts Concerning the Ithaca and Columbus Experimental Roads. Charles H. Hoyt. Illustrated description of the construction of the two experimental roads named. 1500 w. Cornell Civ Eng—Oct., 1910. No. 18273 C.

Rock Crushing.

The Laurin & Leitch Rock-Crushing Plant. Paul C. Van Zandt. An illustrated description of a Canadian plant of interest on account of its size and cost in proportion to the work to be done, and for many unusual features. 3000 w. Eng Rec—Nov. 9, 1910. No. 18665.

Sanitation.

The Declining Death Rate and the Engineer. Editorial on the death rate of the United States for 1909, as shown by statistics gathered by the U. S. Census Bureau. 2500 w. Eng News—Nov. 10, 1910. No. 18455.

Septic Tanks.

Theory, Construction, and Operation of Septic Tanks. Information from a bulletin prepared by N. D. Baker. 2200 w. Met Work—Nov. 26, 1910. No. 18884.

The Present Use of the Septic Tank. Henry N. Ogden. Read before the Am. Soc. of Munic. Imp. Brief review of the development of the septic tank, explaining its value and limitations. 1600 w. Munic Engng—Nov., 1910. No. 18805 C.

Sewage Disposal.

Modern Aspects of Sewage Purification. Ernest McCullough. Historical review of sewerage work and methods. 3500 w. Mfrs' Rec—Nov. 24, 1910. No. 18857.

Sewage Sludge and Its Disposal. A. B. Ogden. The writer's remedy is to utilize sewage sludge for manurial purposes, and he gives information showing success. 4500 w. Surveyor—Nov. 18, 1910. No. 18984 A.

The Agricultural Use and Value of Sewage. J. A. Voelcker. Abstract of a paper before the Assn. of Mgrs. of Sewage Disposal Works (England). Also editorial. Information concerning experience which is not encouraging. 2500 w. Eng News—Nov. 24, 1910. No. 18875.

Sewage Disposal in the Potteries. W. H. Makepeace. Explains how the sewage problem has been solved in the area known as the Potteries, in the northern part of Staffordshire, England. 8000 w. Jour Inst of San Engrs—Oct., 1910. No. 18552 B.

See also Industrial Wastes, under MUNICIPAL ENGINEERING.

Sewers.

Difficult Sewer Reconstruction in Brooklyn. An outline of the methods used in rebuilding and enlarging a sewer where conditions are difficult. Ills. 1200 w. Eng Rec—Nov. 26, 1910. No. 18953.

See also Water Works under WATER SUPPLY.

Sidewalks.

Sidewalk and Curb Grades. Clark G. Anderson. A discussion of the sidewalk question and the elements to be considered in establishing grades. 3000 w. Munic Engng—Nov., 1910. No. 18807 C.

Correlation of Sidewalk and Curb Grades. Clark G. Anderson. Read before the Am. Soc. of Munic. Imp. Discusses the elements to be considered in establishing sidewalk grades. 3500 w. Engng-Con—Nov. 9, 1910. No. 18443.

Supervision.

Supervision of Municipal Work. Will P. Blair. Read before the Am. Soc. of Munic. Imp. Critical discussion of methods. 2000 w. Munic Engng—Nov., 1910. No. 18810 C.

WATER SUPPLY.

Aqueducts.

The Esopus Cut-and-Cover Section of the Catskill Aqueduct. Illustrates and describes the traveling concrete plant used, building 60 feet of aqueduct daily. 4000 w. Eng Rec—Nov. 5, 1910. No. 18404.

Artesian.

See Irrigation, under WATER SUPPLY.

Auburn, N. Y.

The Water Supply from Owasco Lake and the Sanitary Inspection of Its Watershed. J. Walter Ackerman. Considers that absolute safety can only be secured by filtration. 2500 w. Cornell Civ Engr—Nov., 1910. No. 18828 C.

Baltimore.

See Filtration, under WATER SUPPLY.

Dams.

A Buttressed Masonry Dam Reinforced with Steel I-Beams. F. S. Tainter. Illustrated description of a dam at High Bridge, N. J. 1000 w. Eng News—Nov. 24, 1910. No. 18874.

The La Perle Dam; A 130-Ft. Hollow Reinforced-Concrete Dam Near Douglas, Wyoming. Illustrates and describes the method of construction and of securing continuity of foundation. 1500 w. Eng News—Nov. 10, 1910. No. 18448.

See also Hydro-Electric, under ELECTRICAL ENGINEERING, GENERATING STATIONS.

Filtration.

The Cleansing of Filtering Media and Materials for Constructional Work. A.

B. Ogden. Explains media which have been used for filtering. 2200 w. Jour Inst of San Engrs—Oct., 1910. No. 18550 B.

The Toledo Filtration Plant. Explains conditions and gives illustrated description of the new filter plant. 5000 w. Eng Rec—Nov. 26, 1910. No. 18952.

Experimental Filter Plant at Baltimore. Alfred M. Quick. Illustrates and describes a small plant constructed to obtain information needed for a proposed enlarged and improved supply. 1200 w. Eng Rec —Nov. 26, 1910. No. 18957.

See also Concrete, under CONSTRUCTION.

Fire Protection.

Fire Protection in the New York Station of the P. R. R. Brief description of the system installed and its interesting details. 1800 w. Ry & Engng Rev—Oct. 29, 1910. No. 18263.

Glasgow.

The Loch Arklet Extension of the Glasgow Water Supply. Describes the general scheme and the difficulties to be overcome, giving illustrated description f methods of construction. Plate. 2500 w Engr, Lond—Nov. 18, 1910. No. 18997 A.

Irrigation.

The Possibilities of Artesian Water Supplies for Irrigation in Wyoming. Eliot Blackwelder. Predicts that such supplies will soon be used. Ills. 1400 w. Wis Engr—Nov., 1910. No. 18825 C.

Irrigation in the Madras Presidency, 1908-1909. Brief editorial review of the recent report of progress, referring to the various schemes and their results. 1500 w. Engng—Nov. 11, 1910. No. 18683 A.

Pipe Calking.

Pneumatic Calking of Mains with Lead Wool. Colin C. Simpson, Jr. Abstract of a paper before the Am. Gas Inst. giving a detailed account of extensive tests and the satisfactory results. 2500 w. Eng Rec—Nov. 12, 1910. No. 18513.

Pollution.

Pollution of City Water Through Check Valves on Private Fire Protection Plants. J. Walter Ackerman. Read before the Am. Soc. of Munic. Imp. Discusses the connection of secondary supplies and the relations of the check valves, based on his experiment at Auburn, N. Y. 2500 w. Munic Engng—Nov., 1910. No. 18806 C.

Purification.

Some Notes on the History of Water Purification. Information from Messrs. Hering & Fuller's report in connection with the Montreal water supply, giving historical notes on the development of water purification. Also editorial. 7000 w. Eng Rec—Nov. 12, 1910. No. 18509.

Tanks.

Principles Involved in Tank Design. A. Gadd. The present article considers a cast iron water retainer, illustrating modern practice. 1200 w. Mech Wld—Nov. 4, 1910. Serial. 1st part. No. 18570 A.

Water Works.

Manila Water-Works and Sewer Construction. Final report of Major J. F. Case, giving illustrated description of the work. 4000 w. Far East Rev—Aug., 1910. No. 18638 N.

Weirs.

A Rolling Weir on the Trisanna (Walzenwehr an der Trisanna). Alfred Wessely. Illustarted description of an installation in Austria. 1500 w. Zeitschr d Oest Ing u Arch Ver—Oct. 7, 1910. No. 18786 D.

Wells.

Types of Wells; Their Comparative Cost and Merits and Methods of Protection from Pollution. Extract from Water Supply paper No. 255, U. S. Geol. Survey. Myron L. Fuller. Considers types, yield, safety, sources of pollution, protection, etc. Ills. 9000 w. Engng-Con—Nov. 23, 1910. No. 18889.

WATERWAYS AND HARBORS.

Barge Canal.

See Excavation, under CONSTRUCTION.

Canal Haulage.

See same title, under STREET AND ELECTRIC RAILWAYS.

Coast Erosion.

The Phenomena of the Sea, as Regards Encroachment and the Reclamation of the Coast. Frank Latham. A study of sea forces, and a description of Latham's dynamometer. 5000 w. Surveyor—Oct. 28, 1910. No. 18488 A.

Docks.

Baltimore City's New Dock System. Oscar F. Lackey. Illustrated account of the work of constructing the municipal piers; the use of concrete and steel, cost etc. 3500 w. Cornell Civ Engr—Nov., 1910. No. 18827 C.

Genoa.

Projects for the Improvement of Genoa Harbor (Il Piano regolatore del Porto di Genova). Discusses the requirements of the port and plans for its improvement. Ills. Serial. 1st part. 4000 w. Ing Ferro—Oct. 16, 1910. No. 18738 D.

Levees.

See Sacramento River, under WATERWAYS AND HARBORS.

Lighthouses.

Placing a Floating Concrete Crib for a Lighthouse. Illustrated description of methods used at Lloyd Harbor, Long Island, N. Y. 1800 w. Eng Rec—Nov. 19, 1910. No, 18662.

Aids to Navigation on the Pacific Coast. The present article deals with the waters of the coast from Puget Sound northward, including Alaska.

3000 w. Marine Rev—Nov., 1910. Serial. 1st part. No. 18542.

Locks.

The Siphon Lock on the New York State Barge Canal at Oswego, N. Y. D. A. Watt. Illustrated description of a recently completed lock of unusual type, and its operation. 5500 w. Eng News—Nov. 17, 1910. No. 18606.

Palermo.

The Improvement of the Port of Palermo (Sulla Sistemazione del Porto di Palermo). C. Verdinois. Discusses the requirements of the port of Palermo and plans for its improvement. Ills. 7000 w. Riv Marit—Oct., 1910. No. 18731 E + F.

Panama Canal.

Progress in the Construction of the Panama Canal. Recent photographs, with abstract of the annual report. 3000 w. Engineering Magazine—Dec., 1910. No. 18943 B.

The Year's Progress on the Panama Canal. Illustrated review of the last annual report. 1200 w. Sci Am—Nov. 26, 1910. No. 18812.

The Record of a Year's Work on the Panama Canal. A summary of the report of Col. George W. Goethals for the year ending June 30, 1910, with illustrations and map. 11700 w. Eng Rec—Nov. 26. 1910. No. 18956.

Extracts from the Annual Report of the Isthmian Canal Commission for the Year Ending June 30, 1910. Illustrates and describes the design of locks and dams, and the past year's work on the Atlantic and Pacific divisions. 12500 w. Eng News—Nov. 24, 1910. No. 18872.

The Panama Excursion of the American Institute of Mining Engineers. W. L. Saunders. Also editorial. An account of the trip, and commendation of the work. 9000 w. Eng News—Nov. 24, 1910. No. 18876.

An Endorsement of the Panama Canal Work by a Party of Engineers. A testimonial from members of the Am. Inst. of Min. Engrs. who recently returned from a visit to the Isthmus. 1200 w. Eng News—Nov. 17, 1910. No. 18610.

The Panama Canal. G. H. Mee. Early plans and attempts at construction are described and also modern methods and conditions. Ills. 4000 w. Mines & Min—Nov., 1910. No. 18335 C.

Electricity and the Panama Canal. John George Leigh. Discusses points of undertaking of interest to electrical engineers, with a brief survey of the progress. Ills. 2500 w. Elec Rev, Lond—Nov. 4, 1910. Serial. 1st part. No. 18561 A.

Riparian Rights.

Riparian Boundaries. J. B. Davis. Considers their location and their survey. 11700 w. Jour Assn of Engng Socs—Oct., 1910. No. 18696 C.

River Improvement.

Cumberland River Improvements. John Leiper. Illustrated account of the locks and dams on this stream. 1700 w. Mfrs' Rec—Nov. 10, 1910. No. 18422.

River Regulation.

River Regulation under the Austrian Waterways Act (Die Flussregulierungen auf Grund des österreichischen Wasserstrassengesetzes). Hugo Franz. Discusses particularly the state of the work in Bohemia. Ills. Serial. 1st part. 7200 w. Oest Wochenschr f d Oeffent Baudienst —Oct. 15, 1910. No. 18789 D.

Sacramento River.

The Problem of the Sacramento River. H. C. Crafts. Explains the changed condition of this river, discussing the probable causes, and describing the levees constructed along the banks. Ills. 1600 w. Sci Am Sup—Nov. 19, 1910. No. 18646.

Sea Walls.

Design for a Granite Masonry Sea Wall at Boston, Mass. Sections and description of work being done by the Land and Harbor Commission of Massachusetts. 2500 w. Engng-Con—Nov. 9, 1910. No. 18444.

Subaqueous Drilling.

A Large Drill Boat. Illustrated description of drill boat used at Black Rock Harbor, Buffalo, N. Y. 350 w. Eng Rec —Nov. 26, 1910. No. 18954.

Water Powers.

Water-Power Possibilities in Southeastern Alaska. John C. Hoyt. Describes the general topographic features, the geology, climate, vegetation, industrial conditions, and power possibilities. Ills. 2500 w. Eng News—Nov. 24, 1910. No. 18871.

The Utilization of the Rhine for Power Development and Navigation (Zur Frage der Ausnutzung des Rheins für Industrie und Schiffahrt). Fr. Kretz. A review of projects for utilizing the water powers and improving the navigation. Ills. 3500 w. Die Turbine—Sept. 20, 1910. No. 18773 D.

Wharves.

A Reinforced-Concrete Wharf on the Guadalquivir, Spain (Landungssteg aus Eisenbeton am Guadalquivir, Spanien). Juan Manuel de Zafra. Describes the structure and its erection. Ills. 2700 w. Beton u Eisen—Oct. 7, 1910. No. 18795 F.

MISCELLANY.

Canada.

The Scope of Engineering in Canada. R. W. Leonard. A general talk on the engineering outlook in Canada, the opening and developing of the country, and the work that engineers must accomplish. 3000 w. Ap Sci—Nov., 1910. No. 18818 C.

Formulae.

Formulas, Their Uses and Abuses. Alfred Hume. A paper read before the Engineering Association of the South in March, 1897. 3000 w. Eng Rec—Nov. 5, 1910. No. 18406.

ELECTRICAL ENGINEERING.

COMMUNICATION.

Fault Location.

See Submarine Cables, under COMMUNICATION.

Radiotelegraphy.

The Energy Relations of Certain Detectors Used in Wireless Telegraphy. W. H. Eccles. Abstract of paper read before the Physical Society. Describes results of experiments on the properties of detectors. 1000 w. Elect'n, Lond—Nov. 11, 1910. No. 18675 A.

The Periodicities and Damping Coefficients of Coupled Oscillators. J. S. Stone. Abstract of a paper read before the Soc. of Wireless Tel. Engrs. Discusses two coupled oscillatory circuits, reacting results tending to show that some assumptions used are not founded on fact. 700 w.. Elect'n, Lond—Oct. 21, 1910. No. 18283 A.

Wireless Telegraphy and Telephony. Cornelius D. Ehret. An illustrated review of ethereal signaling methods. 4000 w. Sci Am Sup—Nov. 26, 1910. Serial. 1st part. No. 18813.

Wireless Communication as Applied to Railroad Lines. Lee de Forest. Abstract of a paper read before the Assn. of Ry. Tel. Supts. An account of experimental work and explanation of the usefulness to railroads. 2500 w. Elec Rev & W Elec—Nov. 5, 1910. No. 18388.

Submarine Cables.

By Cable to the Arctic. George E. Walsh. An account of the new cable and overland telegraph system to Nome, under the Arctic Circle. 1600 w. Sci Am Sup—Nov. 12, 1910. No. 18460.

Localizing Partial Earth Faults in Submarine Cables. Herbert E. Cann. Describes a method of using Cann's triple test as an earth overlap, illustrating by two examples. 1000 w. Elec Rev, Lond—Nov. 18, 1910. No. 18975 A.

Telegraphy.

The Practical Application of Automatic Telegraphy. Romyn Hitchcock. Abstract of a lecture briefly reviewing the history of the telegraph, and describing the Delany patents. Ills. 3300 w. Sib Jour of Engng—Oct., 1910. No. 18312 C.

Telephone Lines.

Toll-Line Location. H. D. Steele. Suggestions for location of lines and methods of construction. 2200 w. Elec Rev & W Elect'n—Nov. 12, 1910. No. 18525.

Telephone Plants.

The Telephone Plant of the New Pennsylvania Terminal. J. N. C. Graham. Illustrated description of a model equipment. 3000 w. Elec Rev & W Elect'n—Nov. 12, 1910. No. 18523.

Telephone Rates.

Is a Rational Basis Possible for Telephone Rates? Dugald C. Jackson. Read at Buffalo, N. Y., before the Nat. Munic League. Shows the complexity of the problem, and states general principles and factors to be considered. 5000 w. Can Engr—Nov. 24, 1910 No 18880

See also Rates, under GENERATING STATIONS.

Telephony.

Some Technical Features of Telephone Engineering. Abstracts of two lectures. I. Extension of Equipment. R. M. Ferris. II. Extension of the Commercial Range of Transmission. Dr. Jewett. 2800 w. Sib Jour of Engng—Oct., 1910. No. 18313 C.

Uses of the Induction Balance and Its Application in Telephony. C. A. Smith. Illustrated description of the Hughes' audiometer, explaining its usefulness for testing the hearing by doctors, or for testing telephone operators' hearing. 700 w. Elec Rev, Lond—Nov. 4, 1910. No. 18562 A.

Discussion on "Telephone Engineering Around the Golden Gate." Jefferson, N. H., June 29, 1910. Arthur Bessey Smith's paper is discussed. 2500 w. Pro Am Inst of Elec Engrs—Nov., 1910. No. 18843 F.

DISTRIBUTION.

Circuit Breakers.

Alarm-Signalling Devices for Circuit-Breakers. S. Lees. Illustrates and describes types of bell-alarm contact devices and their construction. 1000 w. Elec Rev, Lond—Oct. 21, 1910. No. 18281 A.

Earthing.

Earthing Regulations in Practice. Calls attention to the present system of earthing steel conduits in private houses, and its weakness as a protection. 1000 w. Elec Rev, Lond—Oct. 28, 1910. No. 18482 A.

Switches.

See Electric Power, under MINING AND METALLURGY, COAL AND COKE.

Wiring.

See Electric Driving, under MECHANICAL ENGINEERING, POWER AND TRANSMISSION.

DYNAMOS AND MOTORS.

A. C. Motors.

Alternating-Current Motors and Motor Service. The present number considers induction on rotary-field motors. Diagrams. 1700 w. Mech Wld—Nov. 4, 1910 Serial. 1st part. No. 18572 A.

The Calculation of the Magnetizing Current of Three-Phase Motors (Die Berechnung des Magnetisierungsstromes von Drehstrommotoren). Max Kloss. Describes a new rapid method. Ills. 4500 w. Elektrotech u Maschinenbau—Oct. 9, 1910. No. 18910 D.

The Theory of the Three-Phase Commutator Shunt Motor (Zur Theorie des Drehstromkollektor-Nebenschlussmotors). L. Dreyfus and F. Hillebrand. The first part shows the difference between the induction motor and the commutator motor, caused by the rotor stray flux in the latter machine. Ills. Serial. 1st part. 3500 w. Elektrotech u Maschinenbau. Oct. 16, 1910. No. 18912 D.

Cooling.

Radial Ventilation Slits for the Cooling of Electrical Machines (Ueber die radiale Kühlung elektrischer Maschinen). Theodore Hoock. A discussion of their effectiveness. Ills. 1700 w. Elektrotech u Maschinenbau—Oct. 23, 1910. No. 18911 D.

D. C. Generators.

Switching Phenomena in Self-Exciting Direct-Current Machines (Einschaltvorgänge bei selbsterregenden Gleichstrommaschinen). A. Schwaiger. Gives a graphical method of analyzing circuit-making problems. Ills. 2000 w. Elektrotech u Maschinenbau—Oct. 30, 1910. No. 18913 D.

Foundations.

Construction of Foundations for Electrical Machinery. Bruce H. Page. Illustrated discussion of types of concrete foundations. 1000 w. Elec Wld—Nov. 3, 1910. No. 18343.

Induction Motors.

Squirrel Cage Induction Motors with High Resistance Secondaries. Rudolph E. Hellmund. Discusses features to be considered in connection with their application. 4500 w. Elec Jour—Nov, 1910. No. 18803.

The Irregularities in the Rotating Field of the Polyphase Induction Motor. Charles F. Smith. An experimental study of the causes. Ills. 3500 w. Mech Engr—Nov. 18, 1910. Serial. 1st part. No. 18985 A.

Grounds and Overloads on Induction Motors. R. H. Fenkhausen. Shows where grounds may occur and discusses their effects. Also tells how to prevent overloads. 1800 w. Power—Nov. 15, 1910. No. 18532.

Direct-Current Braking of Induction Motors (Bremsen von Induktionsmotoren mittels Gleichstrom). R. E. Hellmund. A theoretical discussion. Ills. 2300 w. Elektrotech u Maschinenbau—Oct. 2, 1910. No. 18908 D.

Starters.

Induction Motor Hand Starters. R. H. Fenkhausen. Illustrated explanation of the construction and operation of the principal types. 1500 w. Power—Nov. 1, 1910. Serial. 1st part. No. 18269.

The Graphical Calculation of the Starting Resistance of Shunt-Wound Motors (Ein Beitrag zur graphischen Berechnung der Anlasswiderstände für Nebenschlussmotoren). Robert Edler. Mathematical demonstration of a method of calculating the different steps. Ills. 2000 w. Elektrotech u Maschinenbau—Oct. 2, 1910. No. 18909 D.

ELECTRO-CHEMISTRY.

Cells.

The Cathode Equilibrium in the Weston Standard Cell. G. A. Hulett. Abbreviated from the *Phys. Rev.* An experimental study in connection with the hydrolysis of mercurous sulphate by the cadmium sulphate solution in Weston cells. 1800 w. Elect'n, Lond—Oct. 21, 1910. No. 18287 A.

Corrosion.

Corrosion. Notes from Mr. Stromeyer's annual report to the Manchester Steam Users' Assn. 2000 w. Engr, Lond—Nov. 18, 1910. No. 19000 A.

Electric Furnaces.

The Electric Furnace and Its Use. Henry M. Lane. Briefly considers various types adapted to special uses. Ills. 3000 w. Jour Cleveland Engng Soc—Sept., 1910. No. 18272 D.

Data on an Electrical Resistance Furnace. Albert A. Somerville. Describes the furnace and method of control. 700 w. Elec Wld—Nov. 17, 1910. No. 18597.

Norwegian Electric Furnaces. Describes experience with a Hiorth installation for steel production, and the construction of the Soderberg electric induction furnace. Ills. 1200 w. Ir Age—Nov. 24, 1910. No. 18856.

The Frick Electric Reduction Furnace. Dr. Eugene Haanel. Abstract from Bul. No. 3, Canada Dept. of Mines. The largest example of the electric smelting furnace with comparative costs of operation. 4500 w. Ir Trd Rev—Nov. 3, 1910. No. 18355.

Electrolytic Assaying.

Rapid Electrolytic Method of Analysis. R. C. Benner. Explains the principle and apparatus devised to apply it. 1200 w. Min & Sci Pr—Oct. 29, 1910. No. 18366.

Electrometallurgy.

See same title, under MINING AND METALLURGY, Iron and Steel; and Silicon, under MINING AND METALLURGY, Minor Minerals.

Electroplating.

See Accumulators, under Generating Stations.

Nitrogen.

The Equilibrium of the System Consisting of Calcium Carbide, Calcium Cyanamide, Carbon and Nitrogen. M. de Kay Thompson and Robert H. Lombard. Report of research work on the fixation of atmospheric nitrogen, describing the method of carrying out the experiments. 2000 w. Met & Chem Engng—Nov., 1910. Serial. 1st part. No. 18440 C.

ELECTRO-PHYSICS.

Alternating Currents.

Discussion on "Victor Power in Alternating-Current Circuits." Jefferson, N. H., June 29, 1910. The paper by A. E. Kennelly is discussed. 4500 w. Pro Am Inst of Elec Engrs—Nov., 1910. No. 18851 F.

Dielectrics.

See Insulating Materials, under MISCELLANY.

Electromagnets.

Electromagnets (Ueber Elektromagnete). E. Jasse. A detailed review of the theory and design of electromagnets. Ills. Serial. 1st part. 3800 w. Elektrotech u Maschinenbau—Oct. 2, 1910. No. 18907 D.

Induction Coils.

Some Observations on the Action of the Condenser in a Ruhmkorff Induction Coil. Dr. J. W. Waghorn. Describes experiments made to determine what oscillations are set up in the condenser. 3500 w. Elect'n, Lond—Nov. 11, 1910. No. 18676 A.

Radioactivity.

Recent Study of Radium. F. Henrich. Condensed from *Zeit. f. any. Chemic.* A review of recent progress and new research work in the field of radioactivity. 4500 w. Sci Am Sup—Nov. 12, 1910. No. 18463.

The Theory of Radioactive Phenomena (Die Theorie der radioaktiven Erscheinungen). Clemens Schaefer. A review of recent research and progress in this branch of electro-physics. Ills. 7150 w. Zeitschr d Ver Deutscher Ing—Oct. 8, 1910. No. 18921 D.

GENERATING STATIONS.

Accumulators.

Some Recent Problems in Storage Battery Engineering. Joseph Appleton. Considers its application in various power plants, representing results of efficiency. 4000 w. Jour Fr Inst—Nov., 1910. No. 18697 D.

The New Edison Storage Battery and the Part that Electroplating Plays in Its Manufacture. The battery and methods of manufacture are described in detail. Ills. 1000 w. Brass Wld—Nov., 1910. No. 18625.

The 1910 Edison Storage Battery. Walter E. Holland. Read before the Assn. of Edison Ill. Co.'s. Gives results of tests and details of testing, ratings, endurance, etc. 2000 w. Elect'n, Lond—Oct. 21, 1910. Serial. 1st part. No. 18284 A.

Auxiliary Plants.

Discussion on "Emergency Generating Stations for Service in Connection with Hydroelectric Transmission Plants Under Pacific Coast Conditions." San Francisco, Cal., May 7, 1910. A. M. Hunt's paper is discussed. 8500 w. Pro Am Inst of Elec Engrs—Nov., 1910. No. 18842 F.

Centralization.

The Electrification of a Commonwealth. Sylvester Baxter. Discusses the economies of centralized power supply and public utility operation as exemplified in the State of Connecticut. 3500 w. Engineering Magazine—Dec., 1910. No. 18939 B.

Central Stations.

Interconnected Massachusetts Generating Plants. Illustrates and describes the system and operating features of the Greenfield Electric Light & Power Company. 3500 w. Elec Wld—Nov. 3, 1910. No. 18341.

Central Station at Newcastle, Ind. Osborn Monnett. Illustrated description of the mechanical equipment of a small central power and heating station. 1200 w. Power—Nov. 8, 1910. No. 18432.

New Reading Central Station. Illustrated description of this new generating station in connection with the reconstruction of the system of the Metropolitan Electric Co. 2 plates. 4500 w. Eng Rec —Nov. 19, 1910. No. 18666.

Electric Generating and Distributing System in Reading, Pa. Describes the combined lighting and railway equipment of the Metropolitan Electric Co. Ills. 2500 w. Elec Wld—Nov. 17, 1910. No. 18594.

New Power Generating and Distributing System in Reading, Pa. Illustrates and describes a reconstructed power system for increasing the sale of energy and securing economy. A number of unusual features were introduced. 5500 w. Elec Ry Jour—Nov. 19, 1910. No. 18633.

A New Power Scheme for the General Post-Office. A new scheme embracing a main generating station and three substations, is illustrated and described. 3000 w. Engr, Lond—Nov. 18, 1910. Serial. 1st part. No. 18999 A.

The General Post-Office Power Supply. Illustrated description of the new scheme of supply recently put in operation. 2000 w. Elec Rev, Lond—Nov. 18, 1910. Serial. 1st part. No. 18974 A.

Electric Power Supply on the North-East Coast. Illustrates and describes stations utilizing waste heat and gas. 2800 w. Ir & Coal Trds Rev—Nov. 4, 1910. Serial. 1st part. No. 18590 A.

Depreciation.

See same title, under INDUSTRIAL ECONOMY.

Diversity Factor.

Diversity Factor in the Distribution of Electric Light and Power. H. B. Gear. Gives an analysis of the diversity between the various elements of a distribution system and derives the total diversity factor for various classes of business. Discussion. 5000 w. Jour W Soc of Engrs —Oct., 1910. No. 18831 D.

Economics.

Central Station Service. H. R. Leonard. Suggestions for satisfactory service from the commercial standpoint. 1500 w. Elec Rev & W Elect'n—Nov. 12, 1910. No. 18524.

Address of Mr. M. J. Railing to the Birmingham Local Section of the I. E. E. (Abstract). The writer's views on the present position of the electrical industries in England. 2500 w. Elect'n, Lond—Nov. 18, 1910. No. 18977 A.

Address of Mr. T. Harding Churton to the Yorkshire Local Section of the I. E. E. (Abstract). Discusses conditions in England affecting the electrical industries, and the duty of promoting the development of electricity. 2200 w. Elect'n, Lond—Nov. 18, 1910. No. 18978 A.

The Production and Sale of Electrical Energy (Consideraciones generales sobre la Produccion y la Venta de la Energia electrica). Luis Brandon. A general discussion of the economics of central-station management. Serial. 1st part. 1700 w. Energia Elec—Oct. 25, 1910. No. 18742 D.

See also Systems, under STREET AND ELECTRIC RAILWAYS.

England.

See Economics, under GENERATING STATIONS.

Hydroelectric.

Impressions of Recent Hydroelectric Practice in Switzerland. W. F. Durand. Gives results of observations made during the past summer, as shown by the more recent plants in operation and some notable plants under construction. Ills. 3000 w. Eng Rec—Nov. 12, 1910. No. 18508.

Electric Power at Madrid (Transporte de Fuerza a Madrid). Rafael Torres Marino. Describes the Molinar hydro-electric station. Ills. Serial. 1st part. 1800 w. Energia Elec—Oct. 10, 1910. No. 18741 D.

The Tuilière Dam and Hydro-Electric Plant (Le Barrage et l'Usine hydro-électrique de Tuilière). A Claveille. A detailed description of this important plant on the Dordogne, in Southwest France. Ills. Plates. Serial. 1st part. 3000 w. Tech Mod—Oct., 1910. No. 18713 D.

A Project for a Hydro-Electric Plant on the Murg above Forbach (Entwurf eines Wasserkraftwerkes im Gebiet der Murg oberhalb Forbach). Theodor Koehn. A review of a second edition of a book by Professor Rehbock, advocating the erection of a large power house at this point in Bavaria. Ills. 3600 w. Die Turbine—Sept. 20, 1910. No. 18774 D.

Hydro-Electric Plants on the Poglia and its Tributaries of the Adamello Electric Company (Gli Impianti idro-elettrici del Poglia e suoi Affluenti nell'Alta Valle Camonica della Societa Generale Elettrica dell'Adamello). Describes a system of power plants in Northern Italy. Ills. Serial. 1st part. 2700 w. Monit Tech—Sept. 30, 1910. No. 18732 D.

The High Falls Development of the Peshtigo River in Northern Wisconsin. Illustrated detailed description of the dams and hydraulic works, power house, transmission line, etc. 3000 w. Elec Wld—Nov. 24, 1910. No. 18892.

Yngeredsfors Power Plant and 40,000-Volt Transmission Line to Varberg and Mölndal-Gothenburg (Sweden). Henry Chervet. Illustrated detailed description of a power installation on the Atran river. 3000 w. Elect'n, Lond—Oct. 28, 1910. Serial. 1st part. No. 18484 A.

See also Turbine Plants, under MECHANICAL ENGINEERING, HYDRAULIC MACHINERY.

Isolated Plants.

Heat, Light and Power in Buildings. C. M. Ripley. Shows the operating costs by the year of isolated plants in various types of buildings. 4500 w. Heat & Vent Mag—Nov., 1910. No. 18815.

The Central Station Point of View. E. F. Tweedy. Gives an analysis of the figures given by C. M. Ripley from the central station viewpoint. 2000 w. Heat & Vent Mag—Nov., 1910. No. 18816.

Electric Equipment of King Edward Building. Illustrated description of the scheme of electrical illumination and electric power equipment of this London building. 3000 w. Elect'n, Lond—Nov. 18, 1910. No. 18976 A.

A New Generating Plant at a Technical School. Illustrated description of the plant installed at the Northampton Polytechnic Institute, Clerkenwell. 2200 w. Engr, Lond—Oct. 21, 1910. No. 18304 A.

See also Condensers, under MECHANICAL ENGINEERING, STEAM ENGINEERING.

Rates.

Telephone and Other Electric Rate-Making. Benjamin Baker. Discusses the needed readjustment of rates, referring to the rate situation in Boston. 1700 w. Elec Rev & W Elect'n—Nov. 12, 1910. No 18526.

Switchgear.

Discussion on "The Modern Oil Switch with Special Reference to Systems of Moderate Voltage and Large Ampere Capacity. Jefferson, N. H., June 28, 1910. The paper by A. R. Cheyney is discussed. 6500 w. Pro Am Inst of Elec Engrs—Nov., 1910. No. 18845 F.

LIGHTING.

Illumination.

The New Era in Electrical Illumination. Rollin W. Hutchinson, Jr. An illustrated review of the new systems, discussing metal-filament lamps in the present article. 6500 w. Engineering Magazine—Dec., 1910. Serial. 1st part. No. 18942 B.

Incandescent Lamps.

Effects of the Form of Electromotive Force Waves Upon the Life and Efficiency of Incandescent Lamps. An account of tests made by Prof. Charles L. Kinsloe, with editorial comment on results. 2000 w. Elec Wld—Nov. 17, 1910. No. 18596.

The Development of the One-Watt Metal Lamp in the Last Two Years. Hartwig von Loti. Abstract of a lecture before the Elektrotechnische Verein in Vienna. 600 w. Elect'n, Lond—Nov. 4, 1910. No. 18563 A.

See also Illumination, under LIGHTING.

Photometry.

Surface Brightness. J. S. Dow and V. H. Mackinney. Abstract of paper read before the Optical Soc., London. Illustrates a new instrument for its measurement—the "Lumeter" photometer. 3500 w. Elec Engr, Lond—Oct. 21, and 28, 1910. 2 parts. No. 18479 each A.

Train.

See Train Lighting, under RAILWAY ENGINEERING, MOTIVE POWER AND EQUIPMENT.

Vacuum Tubes.

Vacuum-Tube Lighting. D. McFarlan Moore. Refers to investigations and results obtained by the author. 1500 w. Jour Fr Inst—Nov., 1910. No. 18800 D.

MEASUREMENT.

Alternating Current.

Discussion on "Some Recent Developments in Exact Alternating Current Measurements." Jefferson, N. H., July 1, 1910. The paper by Clayton A. Sharp and William W. Crawford is discussed. 4000 w Pro Am Inst of Elec Engrs—Nov., 1910. No. 18847 F.

Frequency Meters.

Non-Vibratory Types of Frequency Meters. C. E. Hiatt. Abstract of an article in the *Phys. Rev.* Describes a modification of this instrument for the purpose of frequency determination and gives an account of its performance. Also discusses a bolometric frequency meter devised by the author. 800 w. Elect'n, Lond—Nov. 18, 1910. No. 18980 A.

Inductive Balances.

See Telephony, under COMMUNICATION.

Laboratories.

The Electrical Laboratory of the Berlin Technical High School (Das elektrotechnischen Versuchsfeld der Technischen Hochschule zu Berlin). W. Reichel and M. Gerstmeyer. Describes the addition built in 1907. Ills. 1700 w. Elek Kraft u Bahnen—Oct. 4, 1910. No. 18904 D.

Potentiometers.

A Remarkable Vector Diagram. Henry Tinsley. A complicated vector diagram is given showing the accuracy to which the phase differences and magnitudes of a. c. in complex circuits can be measured by Dr. C. V. Drysdale's a. c. potentiometer. 1400 w. Elect'n, Lond—Nov. 18, 1910. No. 18979 A.

POWER APPLICATIONS.

Agriculture.

Electric Plowing on the Two-Machine System (Der Elektropflug nach dem Zweimaschinensystem). K. Porsch. Describes the apparatus for plowing by means of winding motors placed at either end of the furrow. Ills. 2000 w. Elek Kraft u Behnen—Oct. 4, 1910. No. 18903 D.

Panama Canal.

See same title, under CIVIL ENGINEERING, WATERWAYS AND HARBORS.

Pumping.

See Electric Pumping, and Pumping Plants, under MECHANICAL ENGINEERING, HYDRAULIC MACHINERY.

Shovels.

Electrically Operated Shovels. W. H. Patterson. Illustrates and describes the mechanical equipment, giving operating costs. 1200 w. Elec Jour—Nov., 1910. No. 18801.

TRANSMISSION.

Insulators.

Electrostatic Limits in High-Tension Transmission-Line Insulators. Explains the condenser effects in insulators, and the advantages secured by the invention of the suspension type of insulator. 1200 w. Elec Wld—Nov. 10, 1910. No. 18447

Line Reconstruction.

Reconstruction Work in Salt Lake City. Illustrates and describes improvements and addition to the system of the Utah Light & Railway Company. 5000 w. Elec Wld—Nov. 10, 1910. No. 18445.

Lines.

Discussion on "The Developed High Tension Net Work of a General Power System," San Francisco, Cal., May 5, 1910. Discussion on Paul M. Downing's paper. 4000 w. Pro Am Inst of Elec Engrs—Nov., 1910. No. 18840 F.

Monocyclic System.

The Mononcyclic System of Distribution for Small Central Stations (Distributions monocycliques pour petites Stations centrales). A. R. Garnier. Describes the system and briefly discusses its advantages. Ills. 1500 w. L'Elecn—Oct. 8, 1910. No. 18716 D.

Poles.

The Calculation and Testing of Siegwart Concrete Poles (Versuche und Berechnung von Siegwartmasten). F. Steiner. Mathematical demonstration of the method of designing and testing concrete poles for electrical transmission lines. Ills. 2000 w. Beton u Eisen—Oct. 7, 1910. No. 18794 F.

Protective Devices.

The Development of Protective Devices for High-Tension Circuits. P. G. Langley. Illustrates and describes types of switching, measuring, and protective equipment. 1800 w. Elec Rev & W Elect'n —Nov. 26, 1910. No. 18861.

Rotary Condensers.

Power-Factor and Rotary Condensers. L. S. Thurston. Explains the advantages of "rotary condensers" in connection with a system of low power-factor. 1500 w. Elec Wld—Nov. 10, 1910. No. 18446.

Rotary Converters.

Voltage Regulation of Compound Wound Rotary Converters. Jens Bache-Wiig. Explains method of operating and of predetermining the voltage characteristic. 2500 w. Elec Jour—Nov., 1910. No. 18802.

Interpoles in Synchronous Converters. B. G. Lamme and F. D. Newbury. A partial analysis of the conditions occurring in synchronous converters and in direct-current generating, indicating wherein interpoles are of greater advantage on d. c. generators than on converters. 11500 w. Pro Am Inst of Elec Engrs—Nov., 1910. No. 18854 F.

Short Circuits.

Short Circuits in A. C. Transmission Networks, their Effect on Generators, Especially Turbo-Dynamos, and Methods of Protection (Kurzschlüsse in Wechselstromnetzen, ihre Rückwirkung auf die Generatoren, insbesondere bei Turbodynamos, und Mittel zur Verhütung dadurch bedingeter Beschädigungen). Gustav W. Meyer. The first part discusses their effect on the stator windings of turbo-dynamos. Ills. Serial. 1st part. 3500 w. Elektrotech Rundschau—Oct. 20, 1910. No. 18902 D.

Transformers.

Discussion on "Determination of Transformer Regulation Under Load Conditions and Some Resulting Investigations. Jefferson, N. H., June 29, 1910. The paper by Adolph Shane is discussed. 3000 w. Pro Am Inst of Elec Engrs—Nov., 1910. No. 18848 F.

Voltage.

Limiting Voltages on Transmission Lines. Erich Hausmann. Considers the critical voltages between conductors, depending on the diameter and spacing. 600 w. Elec Wld—Nov. 17, 1910. No. 18595.

Voltage Regulation.

Some Types of Circuits for Voltage, Current and Power Control. Clarence I. Zimmerman. A diagrammatic study of step-by-step transformer regulators is given in the present article. 2500 w. Elec Rev & W Elect'n—Nov. 19, 1910. Serial. 1st part. No. 18653.

MISCELLANY.

Economics.

Inaugural Address—Institution of Electrical Engineers. S. Z. de Ferranti. (Abstract). Discusses coal conservation, home grown food, and better utilization of labor, and the benefits to be expected from cheap electric power. 7500 w. Elec. Engr, Lond—Nov. 18, 1910. No. 18972 A.

Edison.

The Patents of Thomas Alva Edison. Joseph J. O'Brien. A general review of Edison's work. 1200 w. Elec Wld—Nov. 3, 1910. No. 18340.

Fire Alarms.

A Photo-Electric Burglary and Fire Alarm. Dr. Alfred Gradenwitz. Brief description of a novel alarm, invented by M. E. Defan, based on the properties of selenium under the influence of light. 700 w. Elec Rev, Lond—Nov. 18, 1910. No. 18973 A.

Insulating Materials.

Disruptive Strength with Transient Voltages. J. L. R. Hayden and Charles P. Steinmetz. An addition to an earlier paper on this subject, by the authors. 500 w. Pro Am Inst of Elec Engrs—Nov., 1910. No. 18853 F.

Discussion on "Disruptive Strength with Transient Voltages," "The Electric Strength of Air," and "Dielectric Strength of Oil.' Jefferson, N. H., June 29, 1910. Papers by Joseph L. R. Hayden and Charles P. Steinmetz, by J. B. Whitehead and by H. W. Tobey are discussed. 11000 w. Pro Am Inst of Elec Engrs—Nov., 1910. No. 18852 F.

The Inexactitudes of Oil Testing. Wilfred Yorke. Points out the fallacies of some of the required tests and states a series of tests he considers more acceptable. 2500 w. Elec Rev, Lond—Oct. 21, 1910. No. 18282 A.

A Chemical Specification for Rubber Covered Wires and Cables. C. R. Boggs. Gives a schedule of chemical tests found useful in Germany. 1600 w. Elec Wld —Nov. 24, 1910. No. 18894.

The Dielectric Properties of Air and its Use as an Insulating Material (Propriétés diélectriques de l'Air: son Emploi comme Isolant électrique). Jean Escard. Discusses the factors influencing the dielectric strength of air and gives examples of its use as an insulator. Ills. 4800 w. Rev Gen d Sci—Oct. 15, 1910. No. 18706 D.

Projection Apparatus.

Electrical Projection Experiments. Sydney Whetmore Ashe. Illustrates and describes various projecting instruments and projection experiments. 1200 w. Sci Am —Nov. 5, 1910. Serial. 1st part. No. 18383.

United States.

Electrical Progress in the United States. J. S. Peck. Abstract of the chairman's address before the Manchester Sec. of the Inst. of Elec Engrs. Notes on observations during a recent visit on certain lines of electrical work. 4500 w. Mech Engr—Nov. 11, 1910. No. 18679 A.

Wire Splicing.

Some Tests on Splices in Galvanized Iron Wire. C. T. Rashman. Reports results of a series of tensile tests made on all of the commonly used types. Ills. 900 w. Elec Wld—Nov. 17, 1910. No. 18598.

INDUSTRIAL ECONOMY.

Accounting.

Cost Accounting. John R. Wildman. Discusses the nature of the information sought, the means of obtaining it, and the use to which the information is to be applied, explaining the accounting cost system. 2000 w. Jour of Acc—Nov., 1910 Serial. 1st part. No. 18547 C.

Apprenticeship.

A German Apprentice School. Otto Stolzenberg. Illustrated account of the methods followed. 2500 w. Am Mach—Vol. 33. No. 44. No. 18419.

See also Education, under INDUSTRIAL ECONOMY.

Conservation.

The Conservation Movement. C. W. Hayes. Outlines the trend of the movement, indicating some of the means through which the desired results must be attained. 5000 w. Min & Sci Pr—Nov. 19, 1910. No. 18937.

Cost Systems.

The Importance of Accurate Costs. Holden A. Evans. Aims to show the value of accurate cost-keeping. 3000 w. Am Mach—Vol. 33. No. 45. Serial. 1st part. No. 18472.

Depreciation.

Depreciation and Reserve Funds of Electrical Properties William B. Jackson. Discusses methods of estimating the amount to be charged for depreciation and reserve fund and how the principles should be applied. Discussion. 14000 w. Jour W Soc of Engrs—Oct., 1910. No. 18832 D.

Education.

Industrial Schools and Apprenticeship. Dexter S. Kimball. Discusses industrial education and the training needed. 5000 w. Am Mach—Vol. 33. No. 47. No. 18864.

Practical Education. W. O. Webber Considers defects in modern technical training. 2500 w. Cassier's Mag—Nov., 1910. No. 18616 B.

The Westphalian Mine-Owners Association and Miners' School. Editorial account of the work and methods. 2200 w. Engng—Nov. 18, 1910. No. 18993 A.

The International Congress on Technical Education (Le Congrès international de l'Enseignement technique supérieur). Maurice Bellom. A review of the proceedings of the Congress held in connection with the Brussels Exposition. 3000 w. Génie Civil—Oct. 8, 1910. No. 18722 D.

Engineering.

Presidential Address of Alexander Siemens before the Institution of Civil Engineers. Reviews the history of knowledge from the prosperous period of Greece to the present time, claiming progress is due principally to engineers, and outlining lines of work for further effort. Also editorial. 8500 w. Engng—Nov. 4, 1910. No. 18577 A.

Estimating.

The Elements of Engineering Estimating. A. Suggate. The present number explains the meaning of a cost-estimate. 1200 w. Prac Engr—Nov. 11, 1910. Serial. 1st part. No. 18677 A.

The Oversight and Control of Estimates (Kalkulationskritik und Kalkulationskontrolle). C. M. Lewin. A discussion of the elements which should enter into a cost estimate. 5000 w. Zeitschr f Werkzeug—Oct. 5, 1910. No. 18783 D.

Industrial Accidents.

Safeguarding Against Accidents. Thomas D. West. Read before the Cleveland Supts. & Foremen's Club. Recommends the organization of anti-accident boards, and discusses employer's liability. 3000 w. Ir Trd Rev—Nov. 24, 1910. No. 18879.

Industrial Betterment.

The Betterment of Labor Conditions in the Steel Industry. William B. Dickson. Read before the Am. Ir. & Steel Inst. Deals with accident prevention, relief and pension funds, and the reduction of Sunday labor. 4500 w. Ir Age—Nov. 3, 1910. No. 18323.

Labor.

The Conservation of Labor. Editorial on the conditions of the laboring classes in England, Germany and the United States. 1800 w. Eng News—Nov. 3, 1910. No. 18353.

Collective Agreements between Employers and Workpeople. Information from a report of the Labor Dept. of the Board of Trade, concerning wages, overtime work, youthful labor, arbitration, etc. 2500 w. Ir & Coal Trds Rev—Nov. 4, 1910. Serial. 1st part. No. 18589 A.

See also Shipbuilding, under MARINE AND NAVAL ENGINEERING.

Management.

The Twelve Principles of Efficiency. Harrington Emerson. Seventh article of a series, discussing the fifth principle—the fair deal. 5500 w. Engineering Magazine—Dec., 1910. No. 18946 B.

Systematic Foundry Operation and Foundry Costs. C. E. Knoeppel. The principal elements in foundry accounting and management are discussed in this third article of a series. 5000 w. Engineering Magazine—Dec., 1910. No. 18944 B.

Modern Factory Organization. (Moderne Organisation im Fabrikbetriebe). C. Redtmann. A discussion of German practice in works management. Ills. Serial. 1st part. 1800 w. Zeitschr f Werkzeug—Oct. 5, 1910. No. 18784 D.

Factory Organization (Organisation der Fabrikverwaltung). Martin H. Blancke. A discussion of organization for economical production. Serial. 1st part. 1800 w. Elektrotech Rundschau—Oct. 6, 1910. No. 18900 D.

Technical Requisites for Mass Production (Technische Erfordernisse für Massenfabrikation). F. Neuhaus. The first part discusses estimating, the production of drawings, standardization of parts, etc. Ills. Serial. 1st part. Tech u Wirt—Oct., 1910. No. 18931 D.

See also Shops, under MECHANICAL ENGINEERING, MACHINE WORKS AND FOUNDRIES.

Profit Sharing.

Co-Partnership between Employers and Employees in the Shipbuilding Industry (Co-Partnerschaftsversuche zwischen Arbeitnehmer und Arbeitgeber in der Schiffbau-Industrie). Herman Doerwaldt. A discussion of the labor problem in the shipbuilding industry and the experiment of Sir C. Furness. 2500 w. Schiffbau—Oct. 12, 1910. No. 18767 D.

Strikes.

Labor on the French Railways. Editorial discussion of the recent strike and its causes. 2500 w. Engng—Oct. 21, 1910. No. 18344 A.

Wage Systems.

The Pioneer in Introducing General Piece-Work. Reviews the B. & O.'s experiment of 20 years ago, in which every operation in the mechanical department had its price. 2000 w. Am Engr & R R Jour—Nov., 1910. No. 18425 C.

MARINE AND NAVAL ENGINEERING.

Battleships.

Four Recent Types of "Dreadnoughts" (Quattro Tipi recenti di "Dreadnoughts"). Luigi Barberis. A discussion of recent additions to the battleship fleets of Russia, United States, France and Argentina. Ills. 7500 w. Riv Marit—Oct., 1910. No. 18730 E + F.

Broadside Fire and List (Breitseitfeuer und Krängung). M. Weitbrecht. A mathematical discussion of the list of vessels after a broadside. Ills. 2300 w. Schiffbau—Oct. 26, 1910. No. 18768 D.

Cruisers.

Large German Cruisers. Illustrations and critical discussion of the "Von der Tann" and the "Blucher." 2500 w. Engr, Lond—Nov. 4, 1910. No. 18579 A.

Destroyers.

See Ship Speed, under MARINE AND NAVAL ENGINEERING.

Explosives.

Smokeless Powder. Brief discussion of the recent accident on the U. S. battleship Georgia, the bursting of a 12-in gun, and the use of multiple-perforated powder. 2000 w. Engng—Oct. 21, 1910. No. 18295 A.

Gun Boats.

Shallow Draft Gun Boat. Illustrated description of a new gunboat for Macao, a province in one of the Portugese colonies in China, which is to be used for revenue service. 500 w. Int Marine Engng —Nov., 1910. No. 18390 C.

Hydroplanes.

The Forlanini Hydroplane (L'Idroplano Forlanini). Describes the design of this new hydroplane, and the recent trials on Lake Maggiore. Ills. 2000 w. Industria —Oct. 16, 1910. No. 18735 D.

Launching.

See Steamships, under MARINE AND NAVAL ENGINEERING.

Motor Boats.

Motor Boat Propulsion. The first of a series of articles making a study of this subject. 3000 w. Engr, Lond—Oct. 28, 1910. Serial. 1st part. No. 18500 A.

Navy Yards.

How the Meyer System of Navy Yard Organization Works. A critical discussion of naval inefficiency. 3000 w. Marine Rev—Nov., 1910. No. 18543.

Organization of a Navy Yard Sail Loft and Flag Shop. Holden A. Evans. Describes the organization of these two shops, which has given excellent results. Ills. 2500 w. Marine Rev—Nov., 1910. No. 18541.

The Naval Yard at the Cape of Good Hope. Illustrated detailed description of the recently completed yard at Simon's Town, S. Africa, and the construction work. Plates. 6500 w. Engng—Oct. 28, 1910. Serial. 1st part. No. 18495 A.

Oil Engines.

The Oil Engine in Marine Work. Editorial on the possibilities of the oil engine for ship propulsion. 2500 w. Engr, Lond —Nov. 4, 1910. No. 18584 A.

Oil-Motors for Fishing-Boats. Editorial review of the exhibition at Yarmouth, 1800 w. Engng—Nov. 4, 1910. No. 18575 A.

The North Sea Fisheries and Fishing Exhibition. Reviews the field covered by the exhibition at Yarmouth, as introductory to a detailed description of the exhibits. 2000 w. Engr, Lond—Nov. 4, 1910 Serial. 1st part. No. 18583 A.

Marine Oil Engine; North Sea Fisheries Exhibition, Great Yarmouth. Illustrated description of an engine shown by John I. Thornycroft and Co., Ltd. 1000 w. Engng—Oct. 28, 1910. No. 18499 A.

A Reversing Sulzer-Diesel Marine Oil Engine (Umsteuerbarer Sulzer-Diesel-

Schiffsmotor). Describes the installation in the passenger vessel "Uto" on the Lake of Zürich. Ills. 1600 w. Schweiz Bau—Oct. 22, 1910. No. 18771 B.

Propulsion.

The Propulsion of Ships. John Batey. Gives data for computations of speed, capacity, and powering, based on experiments made by Colonel Rota, in the Italian testing tank. 2000 w. Cassier's Mag—Nov., 1910. No. 18617 B.

Shipbuilding.

Rules for Shipbuilding. Arthur R. Liddell. Reviews recent progress which has made necessary a revision. 2500 w. Engr, Lond—Oct. 21, 1910. No. 18298 A.

The Labor Crisis in British Shipbuilding. Benjamin Taylor. Discusses the fundamental causes of the lockout. 3500 w. Cassier's Mag—Nov., 1910. No. 18615 B.

See also Navy Yards, under MARINE AND NAVAL ENGINEERING.

Ship Speed.

The Influence of Depth on Speed of French Destroyers. Discusses the subject from the observations of recent trials of the French destroyer Tirailleur. Gives analysis of trials. 2800 w. Engr, Lond—Oct. 21, 1910. No. 18297 A.

Steamboats.

Notes on American River Steamboat Practice. T. M. Rees. Information regarding the size of steamboats, tow boats, and barges used on the western rivers of the United States, and matters relating to their building and handling. 2500 w. Int Marine Engng—Nov., 1910. No. 18391 C.

A Proposed Design for a Stern-Wheel River Steamer. Illustrated description of the steamer "John Todd." 800 w. Int Marine Engng—Nov., 1910. No. 18397 C.

Stern Wheel Steamer *Endeavor* for the Congo Mission of the Baptist Missionary Society. Illustrated description of a vessel built in England for service in Africa. 1500 w. Int Marine Engng—Nov., 1910. No. 18398 C.

Stern Wheel Steamers on German Rivers. Illustrates and describes types of vessel in use. 2200 w. Int Marine Engng—Nov., 1910. No. 18393 C.

Shallow Draft Boats in the Pacific Northwest. Illustrates and describes boats used extensively in Alaskan rivers. 1000 w. Int Marine Engng—Nov., 1910. No 18399 C.

Some Data on Paddle-Wheel Steamers. Claude A. Anderson. Reliable information concerning the best marine practice, both foreign and American. 3000 w. Int Marine Engng—Nov., 1910. No. 18392 C.

The Mackenzie River. Illustrated description of a stern paddle-wheel vessel built for the far northwestern part of the North American Continent, and the difficulties met in transporting the machinery and parts of the boat. 1500 w. Int Marine Engng—Nov., 1910. No. 18395 C.

Twin Screw Tunnel Steamers vs. Stern-Wheelers for Service on the Western Rivers. Charles E. Ward. Illustrates and describes the twin-screw tunnel steamer "A. M. Scott," designed to meet conditions on the western rivers of the United States. 1800 w. Int Marine Engng—Nov., 1910. No. 18394 C.

Steam Engines.

See Superheating, under MECHANICAL ENGINEERING, STEAM ENGINEERING.

Steamships.

The Launch of the Olympic. Additional illustrations of this large vessel and description of the launching arrangements. Plate. 800 w. Engr, Lond—Oct. 28, 1910. No. 18503 A.

New Freight Steamships for the Southern Pacific Co. Illustrated description of S.S. El Mundo, the first of four freight steamships for service between New York and Galveston, Texas. 2500 w. Marine Rev—Nov., 1910. No. 18540.

A European Iron Ore Carrying Steamer. Illustrated description of the Swedish steamer, Sir Ernest Cassel, designed to discharge cargo independent of shore equipment. 2000 w. Ir Trd Rev—Nov. 24, 1910. No. 18878.

MECHANICAL ENGINEERING.

AERONAUTICS.

Aeroplane Carriages.

An Improved Wheeled Carriage for Flying Machines. Describes a combination of skids and a skid framework of a wheel chassis. Ills. 1500 w. Prac Engr—Oct. 28, 1910. No. 18487 A.

Aeroplane Propellers.

Aeroplane Propellers. Trans. from *Le Mois Sci. et Ind.* Brief account of experiments by Capt. Dorand on the actual propelling power of propellers. 500 w. Prac Engr—Nov. 11, 1910. No. 18678 A.

Aeroplanes.

A Comparison of the Wright and Curtiss Aeroplanes. Considers the main points of difference. 1200 w. Yale Sci M—Nov., 1910. No. 18628 C.

Aeroplane Stability.

Researches on the Stability of Aeroplanes (Recherches sur la Stabilité des Aéroplanes). Victor Quittner. The first part of the serial discusses longitudinal stability. Mathematical. Ills. Serial. 1st part. 3600 w. Tech Mod—Oct., 1910. No. 18712 D.

Air Resistance.

The Aerial Fleet (La Flotte Aérienne). L. Marchis. A thorough discussion of air resistance and its measurement, and a description and discussion of early and modern airships and aeroplanes. Ills. 27600 w. Tech Mod—Oct., 1910. (Supplement). No. 18715 N.

Airships.

The Gas-Supported Airship. Carl Dienstbach. A discussion of the dirigible balloon and its many designs, describing types and the fascination of air travel. 2800 w. Sci Am—Nov. 12, 1910. No. 18457.

Lessons from the Wellman Expedition. Henry Harrison Suplee. Suggestions for the development of the dirigible balloon. 1200 w. Cassiers Mag—Nov., 1910. No. 18618 B.

Recent European Progress in Dirigible Balloons. W. A. Blonck. Illustrated review of the types and construction. 1200 w. Jour W Soc of Engrs—Oct., 1910. No. 18835 D.

Airship Sheds.

German Airship Sheds. Illustrates and describes the sheds erected at Dusseldorf and at Gotha. 350 w. Sci Am Sup—Nov. 12, 1910. No. 18461.

Altitude.

Measuring the Altitude Reached by Aeroplanes; Harvard-Boston Aero Meet. J. Albert Holmes. Gives map of the aviation field and explains method of measuring altitude used, giving tabulated results. 2000 w. Eng News—Nov. 10, 1910. No. 18449.

Balloon Construction.

An Experimental Investigation of the Strength of the Cordage used in Balloon Construction (Recherches expérimentales sur la Résistance des Cordages usités en Aérostation). Capitaine Do. Discusses the materials used in the manufacture of cordage for this purpose and records the results of tests. Ills. Serial. 1st part. 2400 w. Tech Mod—Sept., 1910. No. 18710 D.

Competitions.

The International Aviation Meet. An illustrated account of performances at Belmont Park. 3500 w. Sci Am—Nov. 5, 1910. Serial. 1st part. No. 18382.

See also Altitude, under AERONAUTICS.

Exhibitions.

Aeroplanes in Paris. Discusses the aeroplanes exhibited at the Paris Show. Ills. 1800 w. Engr, Lond—Oct. 28, 1910. Serial. 1st part. No. 18502 A.

The Second Aerial Navigation Exhibition (La IIe Exposition de Locomotion aérienne). G. Espitallier. Describes the exhibits at the Paris show, Oct. 15-Nov. 2, 1910. Ills. 6300 w. Génie Civil—Oct. 29, 1910. No. 18727 D.

Military.

See Guns, under MISCELLANY.

AUTOMOBILES.

Agricultural.

Mechanical Cultivation (La Culture mécanique du Sol). G. Coupan. Detailed description of the König motor harrow, and the Bajac tractor. Ills. 3000 w. Génie Civil—Oct. 29, 1910. No. 18728 D.

Brakes.

Brakes and Breaking. Discusses brake maintenance. 2000 w. Auto Jour—Oct. 29, 1910. No. 18474 A.

Commercial Vehicles.

Motor Trucks and Delivery Wagons. H. W. Perry. Illustrates and describes some types used and special features of their construction. 2000 w. Ir Age—Nov. 24, 1910. No. 18855.

Hauling Lumber by Motor Truck in Boston. C. F. Marden. Illustrates and describes electric and gas motor trucks especially fitted for the delivery of lumber. 3500 w. Com Veh—Nov., 1910. No 18306 C.

The Commercial Vehicle Competition Organized by the Minister of War and the Automobile Club, 1910 (Le Concours de Véhicules industriels organisé par le Ministère de la Guerre et l'Automobile-Club, en 1910). E. Girardault. Summarizes the characteristics of the contestants and the results of the trials. Ills. 3500 w. Génie Civil—Oct. 1, 1910. No. 18719 D.

Construction.

Hickory. Extracts from a Bul. of the U. S. Forest Service. Deals with its use in automobile work. 3000 w. Automobile —Nov 24, 1910. No. 18881.

Some Examples of the Use of Drop Forgings in Automobile Construction. John Coapman. Explains advantages of this method of construction, showing some of the parts used. 1400 w. Horseless Age—Nov. 2, 1910. No. 18368.

Small Cars (Kleine Wagen). A. H. Simon. Describes various types of cars of small power. Ills. Serial. 1st part. 1800 w. Motorwagen—Sept. 20, 1910. No. 18780 D.

Cunningham.

Cunningham Automobile. Illustrated description of a new car made by this Rochester, N. Y., company. 1500 w. Automobile—Nov. 3, 1910. No. 18358.

Deasy.

The Latest Deasy Cars. Illustrates and describes a new model of 12 h. p. and a new type of 4-speed gear box. 1200 w. Autocar—Nov. 5, 1910. No. 18556 A.

Electric Batteries.

Practical Care of Electric Vehicle Batteries. S. C. Harris. From a paper read before the Elec. Veh. Assn. of Am. Discusses the components of the electric storage battery and the methods for putting a battery into service and maintaining its efficient operation. 2000 w. Com Veh—Nov., 1910. No. 18307 C.

Engineering.

The Advance and Development of Automobile Engineering. F. W. Lanchester. Pres. address before the Inc. Inst. of Auto. Engrs. A general review. 3500 w. Auto Jour—Oct. 22, 1910 Serial 1st part. No. 18279 A.

Exhibitions.

Motor Car Exhibitions at Olympia. Reviews the new features shown, with illustrations. 1500 w. Engr, Lond—Nov. 4, 1910. Serial. 1st part. No. 18581 A.

Auto Technology. Illustrated descriptions of improvements in design observed at the Olympia Exhibition. 3000 w. Auto Jour—Nov. 5, 1910. No. 18559 A.

Carriage Work at Olympia. An illustrated outline of improvements in design with consideration of the latest tendencies and the reasons which have brought them about. 2500 w. Autocar—Nov. 5, 1910. Serial. 1st part. No. 18558 A.

Automobiles at the Brussels Exposition (Motorwagen und Fahrzeugmaschinen für flüssigen Brennstoff auf de Weltausstellung in Brüssel 1910). A Heller. A brief review of the exhibits. Ills. Serial. 1st part. 3200 w. Zeitschr d Ver Deutscher Ing—Oct. 8, 1910. No. 18920 D.

Fuels.

The Heavier Liquid Fuels. Robert W. A. Brewer. A report of experiments and results with various fuels. 2500 w. Autocar—Nov. 19, 1910. No. 18970 A.

Garages.

A Large Electric Vehicle Garage at Toledo, Ohio. Illustrated description of a large garage, equipped for up-to-date service. 1200 w. Elec Wld—Nov. 3, 1910. No. 18342.

Heating.

Keeping the Car Warm in Winter. Illustrates and describes types of heaters used. 1200 w. Horseless Age—Nov. 23, 1910. No. 18886.

Ignition.

A Self-Timing Magneto. Illustrated description of the latest Eisemann model. 1700 w. Auto Jour—Oct. 29, 1910. No. 18475 A.

Bosch Auxiliary Ignition. Illustrated description of an improvement which secures easy starting for single and twin-cylinder engines. 1000 w. Auto Jour—Nov. 5, 1910. No. 18560 A.

Lighting.

The "Carbic" Acetylene System. Illustrated review of the present position of this invention for headlight management. 2500 w. Oct. 29, 1910. No. 18476 A.

Motor Balancing.

Torque and Balancing of Internal-Combustion Engines. A. J. T. Kersey. Compares torque diagrams with different arrangements of cylinders and cranks in the present article. 1500 w. Mech Engr—Nov. 11, 1910. Serial. 1st part. No. 18680 A.

Motors.

The Olympia Motor Exhibition. A general review with description of interesting exhibits. 4000 w. Engng—Nov. 11, 1910. Serial. 1st part. No. 18681 A.

Motor Speed.

Fast *versus* Slow Speed Motors for Cars. Dscusses the merits of the two classes of engines. 2700 w. Engng—Oct. 21, 1910. No. 18294 A.

Motor Valves.

The Slide Valve. Reply to Criticisms. Charles Y. Knight. Reply to a "manufacturer of poppet valve engines," who criticized the slide valve. 8500 w. Autocar—Oct. 22, 1910. No. 18280 A.

Poppet Valves and Slide Valves. A rejoinder to Mr. Knight's remarks on "Some Criticisms of the Slide Valve Engine," by Claude Johnson. 8500 w. Autocar—Nov. 5, 1910. No. 18557 A.

Poppet Valves and Slide Valves. Editorial summary of their respective advantages and drawbacks. 2500 w. Autocar—Oct. 29, 1910. No. 18477 A.

Valve Timing of Automobile Engines. C. T. Schaefer. A discussion of the valve setting of French and American gasolene motors. 1500 w. Am Mach—Vol. 33. No. 46. No. 18601.

Omnibuses.

A Rural Motor-Omnibus Undertaking (Aus der Praxis einer ländlichen Automobilomnibus-Betriebsgesellschaft). Th. Wolff-Friedenau. Describes technical and economic features of a rural motor-omnibus line in Germany. 4200 w. Zeitschr d Mitt Motorwagen Ver—Oct. 31, 1910. No. 18778 D.

Pressure Indicators.

A Good "Tuning-Up" Instrument. Illustrated description of the Okill pressure indicator, explaining its usefulness. 1500 w. Auto Jour—Nov. 19, 1910. No. 18971 A.

Sheffield-Simplex.

The New 25 h. p. Sheffield-Simplex. Illustrates and describes the three-speed gear box on the back axle, the form of distribution gear and magneto drive, and other points of design. 1200 w. Autocar—Oct. 29, 1910. No. 18478 A.

Silencers.

Some of the Latest European Creations. Chester S. Ricker. Illustrates and describes new features introduced for silencing cars, and other improvements. 2000 w. Horseless Age—Nov. 23, 1910. No. 18885.

Sledges.

Automobile Ice-Sled. Frederick K. Lord. Plans and description of a motor-driven sled that can be built cheaply. 1800 w. Sci Am—Nov. 19, 1910. No. 18645.

Speed.

Speed with Security. Marius C. Krarup. Discusses needless causes of traffic disturbance. 1000 w. Automobile—Nov. 10, 1910. Serial. 1st part. No. 18467.

Starters.

A Very Compact Self-Starter. Illustrated detailed description of the latest Simms magneto device. 1500 w. Auto Jour—Oct. 22, 1910. No. 18278 A.

Tires.

Imprènt Method of Testing. Illustrates and describes methods of testing tires to determine the area of contact and desired inflation. 700 w. Automobile—Nov. 10, 1910. Serial. 1st part. No. 18466.

Transmisions.

Some Ideas on the Design of Friction Driven Cars. Victor Jakob. Some features of the design which might be improved, and suggests methods for successful design. Ills. 5500 w. Horseless Age—Nov. 9, 1910. No. 18546.

Worm Driving. Noble and Prewitt. Remarks on the progress evident in the worm drive, its advantages, efficiency, etc., discussing types. Ills. 3500 w. Horseless Age—Nov. 16, 1910. No. 18669.

The Efficiency of the Nacke Chain Transmission (Der Wirkungsgrad der Uebertragungsgetriebe zwischen Motor und Triebrädern eines Kraftfahrzeuges mit Kettenantrieb der Firma E. Nacke, Coswig). H. Scheit and Bobeth. A report of tests by the Royal Saxon Testing Institution. Ills. 2200 w. Zeitschr d Mitt Motorwagen Ver—Oct. 15, 1910. No. 18777 D.

Wheels.

The Segment-Detachable Motor Car Rim. Illustrated description of a device aiming to eliminate troubles in removing tires. 1000 w. Engr, Lond—Oct. 28, 1910. No. 18505 A.

Wolseley.

Wolseley. Illustrated description of the new cars for 1911. 600 w. Auto Jour—Oct. 22, 1910. No. 18277 A.

Wolseley Cars at the Motor Show at Olympia. Illustrated description of cars exhibited and improvements in details. 2500 w. Engng—Nov. 4, 1910. No. 18574 A.

COMBUSTION MOTORS.

Flywheels.

See same title, under MACHINE ELEMENTS AND DESIGN.

Fuels.

See same title, under AUTOMOBILES.

Gas Engines.

The Gas Engine as a Power Factor in Practical Operation. D. R. Ryder. An illustrated article presenting information and letters from users of gas engines of various sizes. 1500 w. Pro Age—Nov. 15, 1910. No. 18518.

Gas-Engine Troubles.

Large Gas Engines and Their Troubles. Frank Foster. Discusses the difficulties which must be overcome by the makers. Ills. 5000 w. Mech Engr—Nov. 4, 1910. No. 18568 A.

Large Gas Engines and Their Troubles. F. Foster. Abstract of a paper read at the Manchester, Eng., Engng. Ex. Discusses the difficulties experienced in their manufacture, describing the improved forms of construction now adopted. 3000 w. Elect'n, Lond—Oct. 28, 1910. No. 18485 A.

Gas Power Plants.

The Design of Small Pressure Gas Plants. A. H. Downes-Shaw. Notes on the requirements and information relating to the design of small plants. Ills. 2200 w. Mech Wld—Oct. 28, 1910. No. 18493 A.

First Large Gas-Engine Installation in American Steel Works. E. P. Coleman. Description and operating characteristics of sixteen blowing-engine units of 2000 H. P. each, eight electric-generating units of 1000-H. P. each, and gas-cleaning plants of the Lackawanna Steel Co. Ills. 13500 w. Jour Am Soc of Mech Engrs—Nov., 1910. No. 18271 F.

Oil Engines.

A Combustion Motor Using Heavy Oil Applied to a Railway Motor Car (Motore a Petrolio pesante applicato ad una Automotrice ferroviaria). E. Mariotti. Detailed description of the motor and car. Ills. Serial. 1st part. 2600 w. Ing Ferro—Oct. 16, 1910. No. 18740 D.

See also same title, under MARINE AND NAVAL ENGINEERING.

Producer Gas.

The Dangers of Producer Gas. From a memorandum as to the use of water gas, suction gas, and other gases in factories, issued by the Factory Dept. of the Home Office. 1800 w. Mech Engr—Oct. 28, 1910. No. 18492 A.

HEATING AND COOLING.

Air Humidifying.

Air Conditioning in Textile Mills (Condizionatura dell' Aria nei Cotonifici). G. Beltrami. A discussion of humidifying apparatus and practice. Serial. 1st part. 1700 w. Industria—Oct. 2, 1910. No. 18736 D.

Cooling Towers.

A Combined Cooling Tower Foundation and Accumulator House. Warren H. Miller. Illustrated description of the unique construction at the Lundy power house of the Paris Gas Co. 1000 w. Eng Rec—Nov. 26, 1910. No. 18955.

Hot-Air Heating.

Twin Furnaces for Residence Heating. Plans and description of a separate pipe system. 1500 w. Met Work—Nov. 5, 1910. No. 18367.

Hot-Water Heating.

A Model Heating System of Glass Tubing. A. Sayers. Illustrates and describes the iodide method of demonstrating the flow of water through pipes. 1500 w. Heat & Vent Mag—Nov., 1910. No. 18814.

Plumbing.

Water Supply for a Public Bath. Illustrates and describes the piping details of the hot and cold water service of a Brooklyn public bath. 2500 w. Met Work—Nov. 19, 1910. No. 18640.

Radiators.

The Relative Efficiency and Resistance to Corrosion of Different Types of Radiators. Herbert Orr. Read before the Nat. Dist. Heat. Assn. Discusses the arguments advanced against sheet-metal radiation, showing their fallacy, and considers other types. 2000 w. Dom Engng —Nov. 19, 1910. No. 18693.

Refrigeration.

Notes on Refrigeration. J. H. Mason. Reviews the history of refrigeration, describing modern methods and apparatus. Plates. Short discussion. 4500 w. Jour S Africa Assn of Engrs—Sept., 1910. No. 18473 F.

Heat and Production of Cold. J. F. H. Koopman. From introduction to a course of lectures on the refrigerating industry at the Technical University of Delft, Holland. 4500 w. Ice & Refrig—Nov., 1910. No. 18384 C.

The Working Fluid in Refrigeration. H. J. Macintire. Observations on the choice of ammonia, carbon dioxide, sulphur dioxide, or other refrigerant as the working fluid in compression refrigerating machines. 1200 w. Ice & Refrig—Nov., 1910. No. 18385 C.

Installing Refrigerating System. F. E. Matthews. Explains how joints are made and leaks detected and repaired. 1200 w. Power—Nov. 22, 1910. No. 18690.

Electric Refrigeration in the Meat Industry. R. L. Lloyd. An illustrated article giving information concerning plants of this character. 1800 w. Elec Rev & W Elec—Nov. 5, 1910. No. 18389.

Charging a Refrigerating System. F. E. Matthews. Gives directions for charging and tables for estimating the amount of charge. 2000 w. Power—Nov. 29, 1910. No. 18969.

The Second International Congress of the Cold (II^e Congres international du Froid). E. Lemaire. A brief review of the proceedings and of the papers read at the refrigeration congress at Vienna, Oct. 6-12, 1910. 2000 w. Génie Civil—Oct. 29, 1910. No. 18729 D.

Ventilation.

Ventilation in Schools. W. A. Evans. Read before the Am. Med. Assn. Explains the scheme of ventilation advised by the writer. 3000 w. Met Work—Nov. 26, 1910. No. 18883.

Problems in Ventilation. A. K. Campbell. Criticism of views of Dr. W. A. Evans on school ventilation and explains author's views on improving indoor atmosphere. 2500 w. Met Work—Nov. 26, 1910. No. 18882.

HYDRAULIC MACHINERY.

Centrifugal Pumps.

The Physical Phenomena Existing in Centrifugal Pumps (Considérations sur les Phénomènes physiques existant dans les Pompes centrifuges). L. Bergeron. Discusses from a physical and practical point of view the various theories of centrifugal-pump action, with special reference to diffusers. Ills. 5000 w. Rev de Mécan—Oct., 1910. No. 18709 E + F.

Electric Pumping.

Discussion on Hydroelectric Power as Applied to Irrigation," San Francisco, Cal., May 6, 1910. Discussion on John Coffee Hays' paper. 5000 w. Pro Am Inst of Elec Engrs—Nov., 1910. No. 18841 F.

See also Pumping Plants, under Hydraulic Machinery.

Gas Pump.

Humphrey Pumps and Compressors. Herbert A. Humphrey. Read before the Manchester Assn. of Engrs. Illustrates and describes designs and recent improvements. 2500 w. Mech Engr—Nov. 18, 1910. Serial. 1st part. No. 18986 A.

Pumping Plants.

Lawrence Avenue Pumping Station. Illustrated detailed description of this station and its equipment for pumping combined sewage of Chicago and mixing it with lake water. 1500 w. Munic Jour & Engr—Nov. 23, 1910. No. 18858.

Electric Pumping Plant for Irrigation in Utah. Describes the plant and the favorable conditions for its development. Ills. 2000 w. Eng Rec—Nov. 12, 1910. No. 18510.

The New Pumping Plants at Lyons (La Transformation des Usines élévatoires de la Ville de Lyon). Describes large installations of centrifugal pumps driven by electric motors. Ills. 2800 w. Génie Civil—Oct. 22, 1910. No. 18725 D.

Pumps.

The Weir Feed Pumps. Illustrated description. 800 w. Col Guard—Oct. 28, 1910. No. 18494 A.

Turbine Plants.

The Turbine Plant at Great Falls, Newfoundland (Die Turbinen der Wasserkraftanlage in Grand Falls, Neufundland). V. Gelpke. Describes the machinery installed by Amme, Giesecke & Konegen, Braunschweig, Germany. Ills. 3300 w. Zeitschr d Ver Deutscher Ing—Oct. 29, 1910. No. 18928 D.

MACHINE ELEMENTS AND DESIGN.

Ball Bearings.

Ball Bearings in Machine Tool Construction. Henry Hess. From a paper read before the Nat. Machine Tool Bldrs. Assn. Illustrates and describes present standard practice of American and German builders. 1800 w. Ir Age—Nov. 3, 1910. No. 18324.

Cams.

Notes on Cam Forms (Betrachtungen über Nockenformen). F. Dinslage and K. Praetorius. A discussion of the laying out of cams for automobile motors. Ills. Serial. 1st part. 1000 w. Motorwagen—Sept. 10, 1910. No. 18779 D.

Crane Hooks.

The Design of Hoisting Hooks. Axel K. Pedersen. Chart, with formulae, showing the relations of the general dimensions. 1000 w. Am Mach—Vol. 33. No. 47. No. 18863.

Curved Rods.

A Simple Method of Determining the Deformation of Rods of Uniform Curvature (Einfaches Verfahren zur Ermittlung der Formänderung eben gekrümmter stabförmiger Körper). R. Baumann. Mathematical explanation of method. Ills. 5500 w. Zeitschr d Ver Deutscher Ing—Oct. 1, 1910. No. 18917 D.

Drawings.

Detail Drawings in Mass Production. Alban Rice. Considers examples of right and wrong dimensioning, detail design, etc. Ills. 2500 w. Am Mach—Vol. 33. No. 46. No. 18603.

Flywheels.

Flywheels for Internal Combustion Engines. D. O. Barrett. Refers only to internal-combustion engines of the single-cylinder, single-acting, four-cycle type with two flywheels. Formulae and deductions are given. 1500 w. Mach, N Y—Nov., 1910. No. 18375 C.

Photography.

The Application of Photography to Industrial Design and to Surveying (Application de la Photographie au Dessin industriel et au Lever des Plans). F. Sautier. Shows how plans of machines and other objects may be developed from photographs, and the application of photographic surveying from balloons. Ills. 2600 w. Tech Mod—Oct., 1910. No. 18714 D.

Rivetted Joints.

Failures of Rivetted Joints in Steam Boilers (Het Scheuren van Klinknaden bij Stoomketels). L. Bienfait. Gives results of experiments by the author, comparing them with the results of previous investigations. Ills. 2600 w. De Ingenieur—Oct. 1, 1910. No. 18932 D.

Shafts.

The Effect of Keyways on the Strength of Shafts. Herbert F. Moore. An account of a brief investigation in the Laboratory of Applied Mechanics, Univ. of Ills., describing the tests and giving data and results. Ills. 3500 w. Univ of Ills, Bul. 42—Dec. 19, 1909. No. 18811 N.

Structural Steel.

Notes on Structural Steel Detailing for Mechanical Draftsmen. Harry Gwinner. Ills. 1500 w. Mach, N Y—Nov., 1910. No. 18380.

MACHINE WORKS AND FOUNDRIES.

Automatic Machines.

Automatic Commutator-Segment Machine. Illustrated detailed description of an automatic machine, shown at the Brussels Exhibition, for slotting commutator bars and soldering them with their strips. 1500 w. Engng—Nov. 11, 1910. No. 18682 A.

Blacksmith Shops.

A Smith Shop with Water Gas Fuel. Illustrates and describes the layout and equipment of new shops at Scranton, Penn., for the D., L. & W. Ry. 2000 w. Am Mach—Vol. 33. No. 46. No. 18600.

Bronze Founding.

Japanese Bronze Founding (Japanischer Bronzeguss). H. Heiland. A brief review of native practice in bronze working. Ills. Serial. 1st part. 1200 w. Giesserei-Zeit—Oct. 1, 1910. No. 18754 D.

Case Hardening.

The Case Hardening and Heat Treatment of Low Carbon Steels. A. C. Sladky and A. F. Schultz. A report of research work. 2000 w. Wis Engr—Nov., 1910. Serial. 1st part. No. 18824 C.

The Gas Process of Case Hardening (Sur la Cémentation par les Gaz). A. Portevin. A general discussion, and a review of the publications of Prof. Giolitti and his assistants. Ills. 9500 w. Rev de Métal—Oct., 1910. No. 18703 E + F.

Chip Briquetting.

The Influence of Chip Briquettes on the Quality of Cast Iron (Wie erklärt sich der Einfluss der Spänebriketts auf das Gusseisen). Engelbert Leber. Offers an explanation of their effect in improving the quality of cast iron. 3800 w. Stahl u Eisen—Oct. 12, 1910. No. 18748 D.

Cutting Tools.

Cutting Speed and Grinding of High-Speed Steels. Wolfgang Koch. Gives opinion of several German firms based on experience, as expressed in reply to an inquiry recently sent. 2200 w. Mach, N Y—Nov., 1910. No. 18374 C.

Heat Treating High Speed Tools. C. P. Berg. Report of experimental work for determining the degree of temper that gives different steels the maximum cutting efficiency. Ills. 2200 w. Am Mach—Vol. 33. No. 45. Serial. 1st part. No. 18471.

Forging.

Cold Forging. J. F. Springer. Illustrated description of a swaging machine and its operation. 1500 w. Sci Am—Nov. 5, 1910. No. 18381.

Foundries.

A Crucible Steel Casting Plant and Its Methods. Illustrates and describes the furnaces and the methods employed. 1600 w. Castings—Nov., 1910. No. 18649.

Foundry Drying Rooms.

Foundry Drying Rooms (Die Trockenkammer in der Giesserei). E. Freytag. A discussion of the design and equipment of drying rooms for moulds and cores. Ills. Serial. 1st part. 2700 w. Giesserei-Zeit —Oct. 15, 1910. No. 18756 D.

Foundry Practice.

Producing Malleable Stove Plate. H. Cole Estep. Illustrated description of the equipment and practice of a large stove plate foundry, in which organization and methods effect great economies. 2500 w. Foundry—Nov., 1910. No. 18314.

See also Patterns, under Machine Works and Foundries.

Galvanizing.

Sherardizing Small Metal Goods in a Connecticut Plant. Illustrates a New Haven, Conn., plant, describing the methods used. 1200 w. Brass Wld—Nov., 1910. No. 18624.

Gear Cutting.

Do Gear Hobbing Machines Cut Flats. F. O. Farwell. A defense of the gear-hobbing machine. Ills. 2200 w. Am Mach—Vol. 33. No. 45. No. 18470.

Cutting Gears on the Slotter. A. Wood. Illustrated explanation of a method of machining large gears. 800 w. Am Mach—Vol. 33. No. 44. No. 18416.

The Cutting of Involute Gears of any Desired Angle of Contact on Planing Machines (Ausführung von Evolventenverzahnungen mit beliebigem Eingriffwinkel auf Maschinen, die nach dem Wälzverfahren arbeiten). Rudolf Plessing. Describes methods of producing gears with angles of contact above 15 degrees. Ills. 2400 w. Zeitschr d Ver Deutscher Ing—Oct. 1, 1910. No. 18918 D.

Grinding Machines.

An Investigation of Grinding Economy (Versuche zur Ermittlung der günstigsten Arbeitsweise der Rundschleifmaschine). W. Pockrandt. Reports tests made to determine the most economical conditions of operation of grinding machines. Ills. Serial. 1st part. 3750 w. Zeitschr d Ver Deutscher Ing—Oct. 15, 1910. No. 18923 D.

Lathes.

Two Historical Lathes. Illustrates and describes the Roberts' screw-cutting lathe of 1820, and the Roberts' sliding lathe of 1817. 1800 w. Engr, Lond—Oct. 21, 1910. No. 18299 A.

The Gridley Automatic Lathe. Illustrated description of a motor-driven single-spindle machine. 600 w. Engr, Lond—Nov. 4, 1910. No. 18587 A.

Automatic Lathe Work. P. V. Vernon. Read before the Rugby Engng Soc. Discusses the effect of automatic work on the time and cost of production, and details of automatic turning machines. 4000 w. Engr, Lond—Nov. 18, 1910. No. 19001 A.

Load Tests of a High-Speed Lathe (Leistungsversuche an einer Schnelldrehbank). Hans Ihle. A report of tests to determine the relation between the load, metal removed, and cutting speed. Ills. 2500 w. Zeitschr f Werkzeug—Oct. 5 1910. No. 18785 D.

Machine Tools.

Machine Tools at the Brussels Exposition. J. O. Newman. Illustrates and describes some American, German, and British exhibits. 4000 w. Cassier's Mag—Nov., 1910. No. 18613 B.

Machine Tools from the User's Standpoint. Read before the Nat. Machine Tool B'lders. Assn. John Riddell's discussion of machine tool design, with instructive criticisms. 3500 w. Ir Age—Nov. 10, 1910. No. 18430.

Can the Efficiency of Shop Tools Be Increased. Gives seven of the twenty articles submitted in a competition. 9500 w. Ry Age Gaz—Nov. 4, 1910. No. 18370.

Molding.

The Making and Molding of a Screw Propeller. Illustrates and describes English foundry practice in molding by a single blade. 1800 w. Castings—Nov., 1910. No. 18650.

The Molding of Ships' Propellers (Die Schifsschrauben und ihre Formmethoden). H. Vetter. Considers their design, methods of making patterns, and molding practice. Ills. Serial. 1st part. 1800 w. Giesserei-Zeit—Oct. 15, 1910. No. 18757 D.

Molding Machines.

The Present Status of Machine Molding and Molding Machines (Gegenwärtiger Stand der Formmaschinenarbeit und des Formmaschinenbaues). Carl Irresberger. A profusely illustrated review, referring principally to German practice. 8000 w. Stahl u Eisen—Oct. 12, 1910. No. 18747 D.

Patterns.

Patternmakers and the Different Ways of Making Castings. Jabez Nall. Shows, by comparison of work, the correct and incorrect methods. Ills. 2500 w. Castings —Nov., 1910. No. 18648.

Pipe Founding.

The Manufacture of Cast-Iron Pipe and Pipe Fittings in Permanent Moulds (Fabrication des Tuyaux et Pièces de Raccords en Fonte avec des Moules permanents). Translations of papers by Simmersbach and Irresberger in *Stahl und Eisen.* Ills. 4000 w. Rev de Métal—Oct., 1910. No. 18704 E + F.

Punch Presses.

Standardizing the Press Room. C. A. Thompson. Explains a scheme for arranging punch presses of various sizes to provide uniform working clearance between ram and bed. Ills. 800 w. Am Mach—Vol. 33. No. 47. No. 18866.

Shop Appliances.

Suggestions in Tool Designing. E. E. Minard. Considers points in connection with jig and fixture designing. 1800 w. Am Mach—Vol. 33. No. 47. No. 18868.

Tools and Dies Used in the Manufacture of Jewelry. Chester L. Lucas. Illustrated description of tools and methods used in factories at Providence, R. I. 3000 w. Mach, N Y—Nov., 1910. No. 18376 C.

Shop Heating.

The Heating of Factory Buildings. Oscar E. Perrigo. Explains the advantages of the positive heated air system, describing a typical installation. Ills. 3000 w. Ir Trd Rev—Nov. 10, 1910. No. 18535.

Shop Lighting.

The Lighting of Industrial Plants (L'Illuminazione degli Ambienti industriali). Francesco Massarelli. A discussion of the hygiene of the eye, modern light sources, and methods of illumination. 3000 w. Industria—Oct. 9, 1910. No. 18734 D.

Shop Practice.

Fixing Work on the Tables of Machine Tools. George W. Burley. Illustrates and describes methods used with the more important machine tools. 1500 w. Mech Wld—Nov. 18, 1910. Serial. 1st part. No. 18987 A.

Methods Used in Building Lathes. F. A. Stanley. Illustrates and describes the processes and tools employed, and the methods used by a Cincinnati company. 2200 w. Am Mach—Vol. 33. No. 44. No. 18418.

Making Locking Bolt Blocks and Spindle Carrier for Gridley Turret Lathe. F. R. Humphrey. Illustrated detailed description. 1000 w. Mach, N Y—Nov., 1910. No. 18379 C.

Machining Power Punch Presses. F. A. Stanley. Illustrates and describes features of the practice of a Cincinnati shop. 1500 w. Am Mach—Vol. 33. No. 46. No. 18602.

Adjustable Die Work on the Ellis Adding Typewriter. Ralph E. Flanders. Fourth and last of a series on the construction, action and manufacture of an adding typewriter. 2500 w. Mach, N Y—Nov., 1910. No. 18378 C.

Threading Sheet Metal Screws. H. W. Sirius. Considers proportions of thread parts, and some points in setting up for threading. Ills. Am Mach—Vol. 33. No. 45. No. 18469.

Broaches and Broaching Processes. C. B. Auel. Illustrates and describes details of the work, broaching tools, finishing allowances and other items. 3000 w. Am Mach—Vol. 33. No. 45. No. 18468.

Shop Kinks. F. E. Lister. Illustrates and describes devices and methods used in the Morris Park shops of the Long Island railroad. 6500 w. Ry Age Gaz—Nov. 4, 1910. No. 18371.

See also Engine Erection, under STEAM ENGINEERING.

Shops.

Organization of a German Pump Plant. F. zur Nedden. Illustrates and describes a specialized German machine shop, organized on stated principles. 1200 w. Am Mach—Vol. 33. No. 46. No. 18604.

Shop Ventilation.

The Economics of Factory Ventilation. Royce W. Gilbert. Discusses the effect of ventilation on the efficiency of the workers. 3000 w. Engineering Magazine—Dec., 1910. No. 18940 B.

The Extraction and Collection of Dust in Manufacturing Operations. Illustrates and describes types of dust collectors and their use. 2000 w. Engr, Lond—Oct. 28, 1910. No. 18504 A.

Tempering.

Hardening Steel with Electricity. E. F. Lake. Considers the different methods by which electricity is used for heating steel to harden and temper it, illustrating and describing apparatus. 3000 w. Am Mach—Vol. 33. No. 47. No. 18867.

Welding.

Oxy-Acetylene in Metal Working. A. Cressy Morrison. Discusses the apparatus used, dangers, utility, etc. 2000 w. Am Mach—Vol. 33. No. 47. No. 18865.

Oxy-Acetylene Welding. J. F. Springer. Illustrated discussion of this process as applied to boiler work. 3000 w. Boiler Maker—Nov., 1910. No. 18438.

The Acetylene Welding Torch. J. F. Springer. Discusses the mixing of gases in the tip of a welding torch, how the high temperature is maintained, how the danger of explosion has been eliminated, and the method of using the torch. 2500 w. Am Engr & R R Jour—Nov., 1910. No. 18426 C.

The "Incanto" Oxy-Acetylene System of Autogenous Welding and Cutting. Apparatus view and description. 2500 w. Prac Engr—Oct. 21, 1910. No. 18288 A.

Wire Drawing.

An Improved Machine for Re-Making Wire Drawing Dies. Describes a machine for re-making dies after they have become worn by the passage of the wire. Ills. 2200 w. Prac Engr—Nov. 18, 1910. No. 18982 A.

MATERIALS OF CONSTRUCTION.

Alloys.

Some Common Defects Occurring in Alloys. Cecil H. Desch. From a paper read before the Inst. of Metals. Detailed discussion of certain defects and their causes. 1800 w. Mech Wld—Nov. 18, 1910. Serial. 1st part. No. 18988 A.

Shrinkage of Alloys During Solidification. Donald Ewen and T. Turner. Read before the Inst. of Metals. Reports an investigation of the shrinkage of antimony-lead, and aluminium-zinc alloys during and after solidification. Ills. 7000 w. Engng—Nov. 11, 1910. No. 18685 A.

On Magnetic Alloys Formed from Non-Magnetic Materials. Alexander R. Ross. Read before the Inst. of Metals. A detailed account of research work and results. 4500 w. Engng—Nov. 4, 1910. No. 18578 A.

"Stellite," a New Alloy. Elwood Haynes. Illustrated description of the alloy, describing its physical and chemical properties, its varieties and uses. 2500 w. Sci Am Sup—Nov. 19, 1910. No. 18647.

Alloy Steels.

Recent Impact Tests at Various Temperatures (Nouveaux Essais au Choc a Températures variables). Léon Guillet and Louis Révillon. Reports results of tests on two nickel steels. Ills. 3000 w. Rev de Métal—Oct., 1910. No. 18700 E + F.

Copper.

Impurities in Tough Pitch Copper. F. Johnson. Abstract of a paper read before the Inst. of Metals. Gives results of investigations made to determine the effect of small quantities of bismuth, silver and aluminium upon the properties of copper when in the rough pitch state. 2000 w. Foundry—Nov., 1910. No. 18315.

Cast Copper of High Electric Conductivity. Dr. E. Weintraub. From a paper read before the Am. Elec.-Chem. Soc. Describes investigations made and the success obtained with "boronizing" copper. 1500 w. Ir & Coal Trds Rev—Nov. 18, 1910. No. 19002 A.

Fatigue.

The Fatigue of Metals and the New Methods of Testing (La Fatigue des Métaux et les nouvelles Méthodes d'Essais). Ch. Fremont. Considers fatigue as a cause of rupture, and discusses Karsten's proposed method for testing tubes. Ills. Serial. 1st part. 5000 w. Génie Civil—Oct. 22, 1910. No. 18726 D.

Metallography.

The Nature of the Slags Included in Basic Bessemer Steel (Sur la Nature des Scories interposées dans l'Acier Thomas). M. Matweieff. A metallographic study of methods by which slags of different characters may be recognized. Ills. 2500 w. Rev de Métal—Oct., 1910. No. 18702 E + F.

Microphotographic Apparatus (Appareil de Microphotographie). F. Robin. With a short note on the use of an oblique light in microphotography by MM. Portevin and Gartner. Discusses the microscope and other apparatus, the lighting of specimens, and the making of microchemical analyses. Ills. 5500 w. Rev de Métal—Oct., 1910. No. 18705 E + F.

Steel.

The Brittleness of Steel in Its Relation to Boilers. C. E. Stromeyer. Abstract from annual report to the Manchester Steam Users' Assn. Reports investigations made to determine the cause and to aid in the selection of proper material for boilers. 2000 w. Ir & Coal Trds Rev—Nov. 18, 1910. No. 19004 A.

Tool Steel.

High Speed Tool Steel. William Vanc. Brandt. Discusses methods of manufacture and heat treatment. 800 w. Ir Age —Nov. 3, 1910. No. 18322.

MEASUREMENT.

Gauges.

A System of Gages for Small Parts. Illustrates and describes a system used in several factories making light machines. 1500 w. Mach, N Y—Nov., 1910. No. 18377 C.

Laboratories.

The Work of the Reichsanstalt in 1909. A brief account of the work during 1909, based on the official report. 3000 w. Engng—Nov. 11, 1910. Serial. 1st part. No. 18684 A.

Melting Points.

The Joly Meldometer. Illustrated description of an instrument for accurately determining the melting points of minerals, metals, etc. 800 w. Mech Engr—Oct. 21, 1910. No. 18291 A.

Pitot Tube.

Determination of Current Direction by Means of the Pitot Tube (Bestimmung von Stromrichtungen mit Pitotrohren). Herr Schuster. Describes this application of the Pitot tube in the testing of water wheels, propellers, etc. Ills. 3300 w. Zeitschr d Ver Deutscher Ing—Oct. 8, 1910. No. 18922 D.

Pressure Gauges.

The Theory of Diaphragm Pressure Gauges (Theorie der Röhrenfedermanometer). H. Lorenz. Mathematical. 2300 w. Zeitschr d Ver Deutscher Ing—Oct. 29, 1910. No. 18930 D.

Testing Metals.

The Thermodynamics of Elastic and Permanent Deformation (Zur Thermodynamik elastischer und bleibender Formänderungen). Rudolph Plank. A mathematical attempt to explain thermodynamically the phenomena of heating in materials under test. Ills. 4950 w. Zeitschr d Ver Deutscher Ing—Oct. 29, 1910. No. 18929 D.

Water Meters.

The "Lea" Water Recorder. Illustrated description of an instrument for the measurement and automatic recording of the flow of water through channels and pipes. 3000 w. Prac Engr—Oct. 28, 1910. No. 18486 A.

POWER AND TRANSMISSION.

Air Compressors.

The Governing of Air Compressors. Remarks on experiments recently carried out on a modern two-stage compressor with inter-cooler, and arranged to unload by the closing of the main air inlet. 500 w. Engr, Lond—Oct. 21, 1910. No. 18303 A.

Two-Cylinder Single-Acting Air Compressor. Illustrated description of a modern, single-acting machine, built in England. 700 w. Engr, Lond—Nov. 4, 1910. No. 18586 A.

See also Turbo-Compressors, under POWER AND TRANSMISSION.

Chain Driving.

High Power Chain Drives. Illustrates and describes noteworthy drives transmitting from 100 to 1000 h. p. 1500 w. Am Mach—Vol. 33. No. 47. No. 18862.

Costs.

Hourly Cost of Running Machinery D. C. Eggleston. Explains method of computing the hourly cost. 1200 w. Am Mach—Vol. 33. No 44 No. 18417.

Electric Driving.

Wiring on Motor-Driven Machinery. R. S. Watson. Discusses the best methods of machine wiring, describing the materials used and giving directions, rules, and tables. Ills. 4500 w. Mach, N Y—Nov., 1910. No. 18373 C.

Electric Drive as Affected by Incorrect Motor Sizes. Morse O. Dellplain. Discusses effects of over-motoring plants. 1200 w. Elec Wld—Nov. 24, 1910. No. 18893.

The Electrical Engineer and the Textile Machinist. F. Nasmith. Abstract of paper read at the Manchester Engng. Ex. Points out the large field for electrical devices in connection with the textile industry. 2000 w. Elect'n, Lond—Oct. 21, 1910. No. 18286 A.

Textile Type Motors, Albert Walton. An illustrated article explaining the requirements for this service and the necessity of designing motors to meet them. 2000 w. Elec Jour—Nov., 1910. No. 18804.

Some Notes on Electrical Plant and Supplies for India. G. E. Wright. Especially considers workshop electrification. Discusses the rating of dynamos and motors, and power house equipment. 1600 w. Elec Rev Lond—Oct. 28, 1910. No. 18480 A.

Discussion on "Interaction of Flywheels and Motors When Driving Roll Trains by Induction Motors." Jefferson, N. H., June 29, 1910. Discussion of F. G. Gasche's paper. 4000 w. Pro Am Inst of Elec Engrs—Nov., 1910. No. 18844 F.

Gas Compressors.

High Pressure Distribution Compressor, Emil Durr. Illustrates and describes two gas compressors recently installed at Millville, N. J. 500 w. Pro Age—Nov. 15, 1910. No. 18519.

Gas Power.

Power Gas and It's Development. J. S. S. Brame. Abstract of a lecture at the Sir John Cass Tech. Inst. The economy, possibilities, and utilization are discussed. 700 w. Elect'n, Lond—Oct. 21, 1910. No. 18285 A.

Lubricants.

Comparison of Lubricating Greases. Horace W. Gillett. Reports comparative tests of mineral and tallow greases, in which both Olsen and Thurston testing machines were used with varying bearing pressures. The tallow greases showed a lower melting point and a lower coefficient of friction. 1700 w. Power—Nov. 8, 1910. No. 18483.

Oils and Greases in Foundries and Metal-Working Plants (Allerei über Oele und Fette in ihrer Anwendung in Giessereien und Metallbearbeitungs-Fabriken). A discussion of lubricants in general, and of their application in metal working. Serial. 1st part. Giesserei-Zeit—Oct. 1, 1910. No. 18755 D.

Lubrication.

An Improved Method of Lubricating the Bearings of Gyrostats. Illustrates and describes improvements invented by Louis Brennan, which maintain a continuous circulation of the lubricant. 1800 w. Prac Engr—Nov. 4, 1910. No. 18567 A.

Mechanical Plants.

Mechanical Features of the Blackstone. Illustrates and describes the heating, ventilation and air cooling of this new hotel in Chicago. 3500 w. Met Work—Nov. 12, 1910. No. 18534.

The Power Plant and Heating System of the Soldan School. The Soldan High School, St. Louis, is a 3-story and basement structure, accommodating 1,600 pupils. Illustrated description of the mechanical equipment for heating, ventilating, lighting, and supplying power for manual training and other uses. 1200 w. Eng Rec—Nov. 12, 1910. No. 18514.

Power Plant of McCormick Building. Osborn Monnett. Illustrated description of the mechanical equipment of this 20-story building in Chicago. 1800 w. Power —Nov. 1, 1910. No. 18265.

Power Plants.

Some Troubles in Connection with Running Electrical Machinery. James A. Seager. Describes cases of trouble and the methods adopted to overcome the difficulties. 2000 w. Elec Rev & W Elect'n —Nov. 12, 1910. No. 18527.

Solar Motors.

Utilizing the Energy of Solar Radiation, the Wind, and Other Intermittent Natural Sources. R. A. Fessenden. Read before the British Assn. at Sheffield. Describes the method by which it is claimed the commercial utilization of such power has been accomplished. 3500 w. Mech Engr —Nov. 4, 1910. No. 18569 A.

A New Proposal to Secure Power on a Large Scale from Intermittent Natural Sources. Editorial discussion of the plan outlined by Prof. R. A. Fessenden for developing power from the sun and wind, comparing it with other schemes. 2000 w. Eng News—Nov. 17, 1910. No. 18608.

Turbo-Compressors.

Turbo-Blowers and Turbo-Compressors (Turbo-soufflantes et Turbo-compressors). A. Rateau. Describes the author's machines and illustrates a number of installations. 2400 w. All Indus—Oct., 1910. No. 18793 F.

Tests of Rateau Turbo-Blowers (Versuche an Rateaugebläsen). H. Bonte. Reports tests for determining the efficiency of turbo-blowers both from electrical and thermal data. Ills. 5500 w. Zeitschr d Ver Deutscher Ing—Oct. 1, 1910. No. 18915 D.

Wind Power.

See Solar Motors, under POWER AND TRANSMISSION.

STEAM ENGINEERING.

Air Pumps.

Factors Affecting Air Pump Capacity. R. M. Neilson. Gives method of computing the capacity based upon the behavior of the mixture of air and vapor under the conditions existing in the condenser. 2000 w. Power—Nov. 29, 1910. No. 18967.

See also Condensers, under STEAM ENGINEERING.

Boiler Cleaning.

Boiler Tube Soot Cleaners. Warren O. Rogers. Illustrates and describes the principle types. 2500 w. Power—Nov. 8, 1910. No. 18434.

Boiler Evaporation.

Curves for Factors of Evaporation. Julian C. Smallwood. Gives chart for a wide range of boiler pressures and feed-water temperatures, with explanation. 500 w. Power—Nov. 22, 1910. No. 18691.

Boiler Failures.

Notes on Causes of Boiler Failure. A. A. Adler. Discusses overpressure, overheating, scale, and other causes. Ills. 1200 w. Power—Nov. 1, 1910. No. 18268.

Tests of Cracked Boiler Plates (Ergebnisse der Untersuchung von Kesselblechen, bei denen Rissbildungen aufgetreten sind). C. Back. Gives the results of physical, chemical, and metallographical tests on three fractured plates. Ills. 3300 w. Zeitschr d Ver Deutscher Ing—Oct. 22, 1910. No. 18925 D.

See also Rivetted Joints, under MACHINE ELEMENTS AND DESIGN.

Boiler Feed Pumps.

See Pumps, under HYDRAULIC MACHINERY.

Boiler Furnaces.

The Combustion of Gas Carbon. W. A. & R. L. Clarke. Read before the Pacific Gas Assn. Illustrates and describes a furnace designed to burn lamp-black, a by-product of the crude oil gas generator. 1500 w. Power—Nov. 15, 1910. No. 18530.

Experiments with Tile Roof Furnaces. A. Bement. Discusses the results of a series of tests made to determine the effect of roof tile on furnace conditions. Ills. 2500 w. Power—Nov. 15, 1910. No. 18531.

Boiler Repairs.

Installing Tubes in Boilers. H. S. Jeffrey. Explains how to remove defective tubes, illustrating and describing tools used in renewing and the method of handling them. 1200 w. Power—Nov. 1 1910. No. 18266.

Boilers.

Water-Tube Boilers. D. Wilson. Abstract of a paper before the Manchester Assn. of Engrs. Discusses the present position of the water-tube boiler, taking a modern electric generating plant as a standard, and considering the results obtained. 3800 w. Mech Engr—Oct. 28, 1910. No. 18491 A.

Boiler Waters.

Feed Water in Steam Boilers. Edward Ingham. Describes various forms of internal corrosion due to unsuitable water scale forming and its cause, and other troubles, and suggests methods of treating the water before using so as to avoid trouble. 2500 w. Ir & Coal Trds Rev—Nov. 11, 1910. No. 18687 A.

Condensers.

The Transmission of Heat in Surface Condensation. George A. Orrok. Describes experimental tests made to determine the heat transfer through various kinds of condenser tubes, and the laws governing its variation. Ills. 14000 w Jour Am Soc of Mech Engrs—Nov., 1910. No. 18270 F.

The Length of Condenser Tubes. R. M. Neilson. Discusses the effect of length, and the problem of determining the best length for any given conditions. 1300 w. Engr, Lond—Nov. 4, 1910. No. 18585 A.

The Effect of Air in Jet Condensers. Paul A. Bancel. Gives the method of figuring the capacities of air pumps. Ills. 2800 w. Power—Nov. 22, 1910. No. 18692.

Condensing Plant at the Brussels Exhibition. Illustrates and describes a new type of steam-condensing plant. 700 w. Engng—Oct. 28, 1910. No. 18497 A.

Plant for the Recovery of Exhaust Steam and for Power Generation of the Ernesto De-Angeli Company, Milan (Impianti con Ricupero del Vapore di Scappamento e nuova Centrale della Stamperia Italiana Ernesto De-Angeli). Carlo Bellini. Examines the economy of condensing and feed-water heating in turbine plants and describes the installation mentioned. Ills. 4500 w. Industria—Oct. 9, 1910. No. 18733 D.

Cooling Towers.

See same title, under HEATING AND COOLING.

Engine Design.

Compound Engine Proportions. Alwin Hofmann. Gives diagrams by means of which any one factor may be determined if the others are given. 2000 w. Power—Nov. 29, 1910. No. 18965.

Engine Economy.

The Influence of Throttling on Steam Consumption (Einfluss der Drosselung auf den Dampfverbrauch). Jar. Hybl. A mathematical investigation, with curves based on Mollier's new steam tables. Ills. 1500 w. Zeitschr d Oest Ing u Arch Ver —Oct. 21, 1910. No. 18787 D.

Engine Erection.

The Fitting and Erecting of Engines. C. L. Browne. Considers the changes in the fitting shop brought about by modern conditions and self-hardening steel. 2500 w. Mech Wld—Nov. 4, 1910. Serial. 1st part. No. 18571 A.

Engine Governors.

Safety Stops for Steam Engines. W. H. Wakeman. Illustrates and describes especial designs of valves, some of which are operated by steam and others by electricity. 1700 w. Power—Nov. 1, 1910. No. 18267.

Engines.

The Development of the Steam Engine (Développement des Sciences mécaniques). V. Dwelshauvers-Dery. A historical review. Ills. 15000 w. All Indus—Oct., 1910. No. 18791 F.

An Engine Built Up of Sections. A. B Gould. Illustrated description of an engine for a locality only accessible by mule pack. 700 w. Power—Nov. 29, 1910. No. 18968.

The Stumpf Unidirectional Flow Steam Engine (La Machine à Vapeur a Equicourant). J. Stumpf. A description of the machine with a review of its performance and applications. Ills. 5000 w. All Indus—Oct., 1910. No. 18792 F.

Exhaust-Steam Regenerators.

Exhaust Steam Regenerators. Charles H. Smoot. Discusses the two general types, one in which the water passes through the incoming steam and the other in which the steam passes through the water. Ills. 5500 w. Power—Nov. 8, 1910. No. 18435.

Fuels.

The Volatile Matter of Coal. Horace C. Porter and F. K. Ovitz. A report on an investigation of the volatile matter in several typical coals—its composition and amount at different temperatures. Ills. 13000 w. Bureau of Mines—Bul. 1. No. 18817 N.

Fuel Testing.

Engineer's Problem in Selecting Coal. George H. Bayne. Gives directions for making standardization tests to determine the comparative evaporative efficiency of various coals. 2300 w. Power—Nov. 22, 1910. No. 18689.

Mechanical Stokers.

Under-Feed Automatic Stokers. J. F. Springer. Illustrated review of the development of this type. 2500 w. Power—Nov. 15, 1910. No. 18529.

Bennis Stokers at the Gemeente Electriciteitswerken, Amsterdam. Illustrated description of a very complete installation of sprinkling stokers and appliances. 600 w. Engng—Nov. 18, 1910. No. 18991 A.

The Triumph Stoker. An illustrated description of a stoker of the sprinkler type. 1200 w. Col Guard—Nov. 18, 1910. No. 18989 A.

Smoke Prevention.

The Problem of Smoke Abatement. D. T. Randall. Abstract of paper read before the Boston engineers. Considers localities using bituminous coal high in volatile matter. 4500 w. Power—Nov. 15, 1910. No. 18533.

The Economy of Smoke Prevention. J. A. Switzer. Considers the efficiency and operating cost of proper steam-jet devices for the boiler furnace. 1500 w. Engineering Magazine—Dec., 1910. No. 18945 B.

Steam Piping.

Design and Erection of Steam Piping. Francis H. Davies. Discusses the fundamental principles to be followed, and the materials which should be used. Ills. 4000 w. Power—Nov. 15, 1910. No. 18528.

Superheaters.

Superheaters. S. Lees. Discusses the layout of the superheater. 700 w. Elec Rev, Lond—Oct. 28, 1910. No. 18481 A.

Superheating.

A Case of Marine Superheating. Gives two engineer's logs showing the effect of superheating on the economy of marine engines. Table. 600 w. Engr, Lond—Nov. 18, 1910. No. 18998 A.

Turbine Design.

The Steam Turbine in Germany. F. E. Junge and E. Heinrich. Points out the tendency of the principal types of axial turbines to merge into one standard design. 3000 w. Power—Nov. 8, 1910. No. 18433.

Turbine Governing.

Oscillations of Generators in Parallel and Compensation by Modern Indirect Governors (Das Pendeln parallel geschalteter Maschinen und die Kompensation bei modernen indirekten Regulatoren). Herr Kröner. A mathematical discussion of the governing of steam turbines driving alternators in parallel. Ills. Serial. 1st part. 3000 w. Zeitschr f d Gesamte Turbinenwesen—Oct. 10, 1910. No. 18776 D.

Turbine Rotors.

Recent Developments in Drum Rotors for Steam Turbines (Ueber neuere Lauftrommeln für Dampfturbinen). W. Gentsch. An illustrated review of recent types of construction. 4500 w. Die Turbine—Oct. 20, 1910. No. 18775 D.

Turbines.

The Modern Parsons Turbine. Brief review of important improvements since its advent in 1884. 2000 w. Engr, Lond—Nov. 11, 1910. No. 18686 A.

The Steam Turbine and its Applications (Sulla Turbina a Vapore e sulle sue Applicazioni). E. Peretti. A review of existing types, and of stationary and propulsive applications. Ills. Serial. 1st part. 3200 w. Ing Ferro—Oct. 16, 1910. No. 18739 D.

Turbine Troubles.

See Steam Turbines, under MARINE AND NAVAL ENGINEERING.

TRANSPORTING AND CONVEYING.

Aerial Tramways.

Rapid Growth in the Use of Aerial Tramways. William Hewitt. Illustrates and describes applications of overhead transport. 600 w. Cassier's Mag—Nov., 1910. No. 18620 B.

Aerial Tramways for Blast-Furnace Charging (Die Verwendung der Elektrohängebahn zur Hochofenbegichtung). Hubert Hermanns. Illustrates a number of installations and describes their operation. 3000 w. Elektrotech u Maschinenbau—Oct. 30, 1910. No. 18914 D.

Conveyors.

A Wooden-Apron Conveyor Carrying Miscellaneous Freight from Wharf to Warehouse. Illustrated description of a conveyor performing this work at a Seattle wharf. 1000 w. Eng News—Nov. 10, 1910. No. 18452.

Coal-Conveyor at the Brussels Exhibition. Illustrated description. 1000 w. Engng —Oct. 28, 1910. No. 18496 A.

Handling Gravel Mechanically. H. H. Kress. Illustrates and describes appliances for conveying material. 800 w. Cassier's Mag—Nov., 1910. No. 18619 B.

Ore Handling.

The Mechanical Handling of Ores by Travelling Bridges Carrying a Revolving Car-Dumping Device (La Manutention mécanique des Minerais par des Ponts roulants culbuteurs a grand Rendement). Siegfried Lévi. Describes an installation for unloading mine cars at the de Landres iron mines in France. Ills. 1300 w. Génie Civil—Oct. 8, 1910. No. 18720 D.

Transporters.

2½-Ton Electric Transporter. Illustrations, with brief description of a transporter erected at Fleetwood Docks. 350 w. Engng—Nov. 18, 1910. No. 18992 A.

Electrical Equipment of Travelling Transporters (Elektrische Einrichtungen an fahrbaren Verladebrücken). O. Pollok. Describes the electrical operation of a number of ore and coal handling and storage plants. Ills. 2750 w. Zeitschr d Ver Deutscher Ing—Oct. 1, 1910. No. 18916 D.

See also Ore Handling, under TRANSPORTING AND CONVEYING.

MISCELLANY.

Gas Works.

Mechanical Engineering Problems in Illuminating Gas Works. J. A. P. Crisfield. Discusses problems in the design and operation of a gas works and their solution. Ills. 2500 w. Jour Fr Inst—Nov., 1910. No. 18699 D.

Glass Making.

Sievert's Mechanical Glass-Making Processes (Emploi des Procédés mécaniques Sievert en Verrerie). V. Bertrand. Describes the recently perfected processes of Paul Sievert, the products, etc. Ills. Serial. 1st part. 2500 w. Génie Civil—Oct. 8, 1910. No. 18721 D.

Guns.

Guns for Attacking Airships. From *Artilleristische Monatshefte.* An illustrated review of the present state of the problem and its peculiarities. 2200 w. Sci Am Sup—Nov. 12, 1910. No. 18459.

Kneading Machines.

Bread Making and Mechanical Kneaders (La Panification et les Pétrins mécaniques). J. A. Montpellier. Discusses mechanical kneaders from the point of view of hygiene, and describes various types. Ills. Serial. 1st part. 2500 w. Tech Mod—Sept., 1910. No. 18711 D.

Printing Machinery.

The Technology of Bank-Note Printing (Die technischen Anforderungen des Wertpapierdruckes). G. Nicolaus. A review of processes and apparatus for the printing of paper money. Ills. Serial. 1st part. 5800 w. Zeitschr d Ver Deutscher Ing—Oct. 22, 1910. No. 18924 D.

Sugar Machinery.

A Three-Roller Sugar-Cane Mill. Gavin A. Renton. Illustrated description. 2500 w. Mech Wld—Oct. 21 & Nov. 18, 1910. Serial. 2 parts. No. 18981 each A.

MINING AND METALLURGY.

COAL AND COKE.

Accidents.

Methods of Dealing with Fires, Explosions and Falls in Mines. From the presidential address of Alfred J. Tonge, at meeting of the Manchester Geol. & Min. Soc. Diagrams. 3500 w. Ir & Coal Trds Rev—Nov. 11, 1910. No. 18688 A.

Alabama.

Kellerman Mine, Kellerman, Ala. Neill Hutchins. Illustrated description of the methods of preparing the coal, and of transportation facilities. 3000 w. Mines & Min—Nov., 1910. No. 18329 C.

Alberta.

Annual Report of Department of Public Works of the Province of Alberta, Coal Mine Branch. Information concerning output, development, etc., of the different coal mining districts in the Province of Alberta. 6000 w. Can Min Jour—Nov. 1, 1910. No. 18414.

China.

The Pinghsiang Colliery. K. P. Swensen. An illustrated account of the development and methods at this Chinese mine. 3000 w. Min & Sci Pr—Oct. 29, 1910. No. 18363.

Coal Cutting.

The Use of Coal Cutting Machinery. R. H. Rowland. Considers the advantages and disadvantages of the adoption of undercutting machines in mines. 3500 w. Eng & Min Jour—Nov. 26, 1910. No. 18950.

Coal Tar.

Coal Tar—Its Products and Uses. William W. Borman. Shows the economic importance of the coal tar industry. 6000 w. Pro St Louis Ry Club—Oct. 14, 1910. No. 18694.

Coke-Oven Linings.

The Destruction of Coke-Oven Linings (Ueber Koksofensteinzerstörungen und deren Ursachen). F. Schreiber. A discussion of the causes. Ills. 3000 w. Stahl u Eisen—Oct. 26, 1910. No. 18752 D.

Electric Power.

The Design of Mining Switchgear. G. M. Harvey. Brief discussion of points in design which need particular attention to secure safety, reliability and economy. 1200 w. Elec Rev, Lond—Nov. 11, 1910. No. 18674 A.

Proposed Rules for Use of Electricity in Mines. Gives rules recommended as a basis for the enactment of uniform legislation on electrical practice in mines. 8500 w. Min Wld—Nov. 26, 1910. Serial. 1st part. No. 18963.

Explosions.

Explosion at Palau No. 2 Mine. Discusses the extent and cause of the explosion. Ills. 2400 w. Mines & Min—Nov., 1910. No. 18328 C.

Handling.

A Coal-Loading Machine. William Whaley. Illustrated description of apparatus for use in mines to load coal cars. 1500 w. Mines & Min—Nov., 1910. No. 18330 C.

Kentucky.

The Elkhorn Coking Coal Field to Be Developed. Map and description, with information regarding the property. 4000 w. Mfrs' Rec—Nov. 10, 1910. No. 18420.

Mine Dust.

French Coal-Dust Experiments. M. Taffanel. Abstracted from reports by the Comité Central des Houillères de France. An account of the first and second series of experiments is given in this number. 1800 w. Col Guard—Oct. 21, 1910. Serial. 1st part. No. 18293 A.

Mine Laboratories.

Mine Laboratory Work at Gary, W. Va. Describes the equipment of the laboratory, and methods of sampling coal, coke, and mine air. Ills. 1600 w. Mines & Min—Nov., 1910. No. 18332 C,

Mine Roofs.

The Chemical Characteristics of the Roofs of Lignite and Bituminous Coal Seams (Zur chemischen Charakteristik der Hangendesteine von Braun- und Steinkohlen). A. Lissner. A report of an investigation of a large number of samples. Serial. 1st part. 2500 w. Oest Zeitschr f Berg- u Hüttenwesen—Oct. 15, 1910. No. 18758 D.

Mine Waters.

The Clarification of Mine Waters in the Ems District (Klärung von Zechenabwasser im Emschergebiet). Herr Müller. Describes plants for the clarification of washing water. Ills. 2000 w. Glückauf—Oct. 1, 1910. No. 18760 D.

Mining.

American vs. European Coal Mines. Henry M. Payne. Discusses points of difference in methods and conditions 2200 w. Mines & Min—Nov., 1910. No. 18326 C.

American Longwall Mining Methods. Henry M. Payne. Compares with the system as used in England, and gives an example of room-and-pillar operation converted into a longwall mine. 1600 w. Eng & Min Jour—Nov. 19, 1910. No. 18659.

Mining Costs.

The Rise in the Cost of Production. Isaac Hodges. Presidential address at meeting of Midland Inst. of Min., Civ., & Mech. Engrs. Discusses the increase of working costs in coal mines during the past-half century, the rate of increase and the causes. 3000 w. Col Guard—Nov. 18, 1910. No. 18990 A.

Mining Engineering.

Expert Engineering at Colliery. Alexander Anderson. Address before the Assn. of Min. Elec. Engrs. discussing the work of the colliery manager, consulting engineer, the manufacturer, and the colliery engineer. 3500 w. Ir & Coal Trds Rev—Nov. 18, 1910. No. 19003 A.

Oklahoma.

Coal Mining in Oklahoma. Willis P. Thomas. Information concerning the extent of development, quality of the coal, methods of mining, hauling, and preparing. Ills. 2200 w. Mines & Min—Nov., 1910. No. 18325 C.

Philippines.

Philippine Coal. Warren D. Smith. Illustrated article, giving maps and description of mines now in operation, and the location of other deposits, their quality, etc. 2000 w. Far East Rev—Sept., 1910. No. 18639 N.

Picking.

See Washing, under COAL AND COKE.

Rescue Methods.

First-Aid Contests. An illustrated account of the annual contests by teams of the different collieries of the Pennsylvania anthracite region. 4000 w. Mines & Min—Nov., 1910. No. 18327 C.

Rescue Stations.

Rescue Stations in Illinois Coal Mining Localities. R. Y. Williams. Considers the design and equipment, the character of the training, advantages, etc., general discussion. 10000 w. Jour W Soc of Engrs—Oct., 1910. No. 18834 D.

Washing.

Coal Washing v. Picking. Illustrates and describes the Greaves coal washer, giving such information as will enable a comparison to be made of the relative values of picking and washing. 3000 w. Ir & Coal Trds Rev—Nov. 4, 1910. No. 18588 A.

Extensions to Plant at the Dean and Chapter Colliery. Illustrates and describes a "Luhrig" washery, supplying coal to 100 coke ovens, a recovery plant, etc. 1500 w. Ir & Coal Trds Rev—Oct. 28, 1910. No. 18507 A.

Coal-Washing Plant at the Bergmannsgluck Mine, Buer, Germany (Die Kohlenwäsche auf der Schachtanlage Bergmannsgluck der Kgl. Berginspektion 3 in Buer i. W.). M. Hirsch. Illustrated description of the leading features of the plant. Sections of the washery. 2400 w. Glückauf—Oct. 29, 1910. No. 18765 D.

See also Mine Waters, under Coal and Coke.

COPPER.

Alaska.

Chitins Copper Region in Southern Alaska. L. W. Storm. Explains the present conditions, describing location, deposits, etc. Map. 2500 w. Eng & Min Jour —Nov. 19,. 1910. No. 18656.

Arizona.

Copper Deposits of Northern Yuma County. Edwin Higgins. Describes the region, the deposits, and their development. Map. 2500 w. Min Wld—Nov. 5, 1910. Serial. 1st part. No. 18410.

Blast-Furnace Charges.

A Smelting Charge Calculator. Illustrated description of Balling's new instrument. 800 w. Sci Am Sup—Nov. 12, 1910. No. 18462.

Bolivia.

Bedded Copper Deposits of Carangas, Bolivia. Robert Hawxhurst, Jr. Describes ore-bearing strata 600 ft. thick and outcrops for two miles. Mining conditions favorable. Ills. 3000 w. Eng & Min Jour—Nov. 5, 1910. No. 18402.

Hydrometallurgy.

The Outlook for Hydrometallurgy of Copper. William E. Greenawalt. Discussion of the limitations of smelting processes, difficulties of the wet methods and present processes. 4000 w. Eng & Min Jour—Nov. 12, 1910. No. 18520.

The Greenawalt Electrolytic Process. William E. Greenawalt. Describes this process in which the copper is dissolved by dilute acid chloride solutions, and then precipitated by electrolysis, etc. 5000 w. Eng & Min Jour—Nov. 26, 1910. No. 18899.

Mexico.

Mining Methods Employed at Cananea, Mex. Morris J. Elsing. Reports the geological and labor conditions, describing methods. Ills. 3500 w. Eng & Min Jour—Nov. 5, 1910. Serial. 1st part. No. 18403.

Mines of Zomelahuacan, Veracruz, Mexico. Martin Fishback. Illustrated account of a district having a large area of low-grade sulphide ore. 2000 w. Eng & Min Jour—Nov. 19, 1910. No. 18658.

Nevada.

Fourth Annual Report of Nevada Consolidated. Gives the report practically in full. Ills. 2000 w. Eng & Min Jour—Nov. 19, 1910. No. 18654.

Prospecting.

See same title, under Mining.

Slag.

Lead and Copper Slags. James A. Barr. Information concerning slags, the effect of slag constituents, and related data. 2500 w. Min & Sci Pr—Nov. 5, 1910. No. 18537.

Smelters.

A Small Modern Copper-Smelting Plant. Charles C. Christensen. Mathematical determination of a furnace of stated capacity. 2500 w. Min Wld—Nov. 26, 1910. No. 18959.

The New International Smelter at Tooele, Utah. Leroy A. Palmer. Illustrated description of the plant and its equipment. 3500 w. Min Wld—Nov. 19, 1910. No. 18671.

The International Smeltery at Tooele, Utah. C. H. Repath and A. G. MacGregor. Abstract of paper read before the Utah Soc. of Engrs. Illustrates and describes the smelter and its operation. 1200 w. Eng & Min Jour—Nov. 26, 1910. No. 18898.

Tennessee.

The Work of the Tennessee Copper Company. Karl R. Morgan. Describes methods of mining and smelting and other features. 2800 w. Min & Sci Pr—Nov. 19, 1910. No. 18938.

GOLD AND SILVER.

Australia.

The Gold Mining Industry of Victoria. A critical discussion of the present conditions and opportunities for improvement. 3500 w. Aust Min Stand—Oct. 5, 1910. No. 18599 B.

British Columbia.

Portland Canal Mining District, British Columbia. Newton W. Emmens. An illustrated description of the country and its geology, and briefly reviewing its history. 2200 w. Min Wld—Nov. 12, 1910. Serial. 1st part. No. 18544.

Cobalt.

The Rehabilitation of the La Rose Con. Mines. Alex. Gray. A report of the present condition of these Cobalt silver mines. 3000 w. Min Wld—Oct. 29, 1910. No. 18261.

See also Prospecting, under Mining.

Colorado.

Mining in the San Juan. William H. Storms. An account of present conditions as observed during a recent visit. Ills. 2500 w. Min & Sci Pr—Nov. 5, 1910. Serial. 1st part. No. 18539.

Mining in the Silverton Quadrangle, Colorado Arthur Lakes Illustrated description of the geology and mining development of this region 2000 w. Min Wld—Nov. 5, 1910. No. 18412.

Cyaniding.

Modified Cyanide Process. A description of the process of Mr. John Collins Clancy, in which calcium cyanamide is substituted in part or entirely for sodium cyanide and potassium cyanide. Electrolysis plays an important part. Also editorial. 6000 w. Met & Chem Engng—Nov., 1910. No. 18441 C.

French Guiana.

The Gold Fields of French Guiana and the New Method of Dredging. Albert F. J. Bordeaux. History and illustrated description of the coutnry and conditions, the geology, placers, dredging methods, costs, etc. 8800 w. Bul Am Inst of Min Engrs—Nov., 1910. No. 18836 F.

Gold Coast.

The Gold Coast: The "Sick Man" of the Mining Industry. Joseph Ralph. Explains conditions, discussing the climate, labor, etc. 7500 w. Min Jour—Oct. 22, 1910. Serial. 1st part. No. 18290 A.

Nevada.

National, Nevada. H. C. Cutler. Describes the geology, present development, and promise of the camp. Ills. 1500 w. Min & Sci Pr—Nov. 5, 1910. No. 18538.

Ontario.

The Porcupine Goldfield. A. L. Simon Map and illustrated description of the district and its development. 2200 w. Mining Mag—Nov., 1910. No. 18947 B.

Porcupine Gold Deposits. Reginald E. Hore. Illustrated description of the deposits of this promising region. 1700 w. Can Min Jour—Nov. 1, 1910. No. 18413.

Placers.

Mining Cement Gravel at Altar, Mexico. Illustrates and describes old and new methods of recovering gold from cemented gravel in absence of water. 1800 w. Mines & Min—Nov., 1910. No. 18334 C.

See also Siberia, under Gold and Silver.

Siberia.

Native Methods in Siberia. Fred L. Lowell. Illustrates and describes working methods used by Russians, Chinese and Koreans in the placer mining regions of eastern Siberia. 1500 w. Min & Sci Pr—Nov. 5, 1910. No. 18536.

IRON AND STEEL.

Analysis.

Analysis of Titaniferous Iron Ores. W. D. Brown. Explains the method of analysis used by the writer. 2000 w. Met & Chem Engng—Nov., 1910. No. 18439 C.

Standardization of Permanganate Solutions in the Reinhardt Titration Method (Titerstellung von Kaliumpermanganatlösungen zur Eisentitration nach Reinhardt). A criticism by Dr. L. Brandt of a paper in *Stahl und Eisen* for March 9, 1910, with a reply by the author. 4500 w Stahl u Eisen—Oct. 26, 1910. No. 18753 D.

Blast-Furnace Accidents.

Preventable Blast Furnaces Accidents. R. H. Sweetser. Brief discussion of methods of guarding against explosions of "normal" gas and blowing-in gas. 2500 w. Ir Age—Nov. 3, 1910. No. 18321.

Blast-Furnace Gas.

The Origin of the Hydrogen in Blast-Furnace Gas (Die l'Origine de l'Hydrogène dans les Gaz de Hauts-Fourneaux). Henry Le Chatelier. Proposes a simple theory based on the results of Wysor and Brown. 1000 w. Rev de Métal—Oct., 1910. No. 18701 E + F.

See also Central Stations, under ELECTRICAL ENGINEERING, Generating Stations; and Gas Power Plants, under MECHANICAL ENGINEERING, Combustion Motors.

Blast Furnaces.

New Furnace B—Detroit Iron & Steel Co. Illustrated description of recent extensions which have doubled the capacity of the plant. 1200 w. Ir Trd Rev—Nov. 17, 1910. No. 18632.

Blowers.

An Electrically Driven Blowing Engine. Illustrates and describes a vertical blast furnace blowing engine at Ormesby Iron Works, driven by electricity. 600 w. Engr, Lond—Oct. 21, 1910. No. 18305 A.

The Schleifmühle Blowers (Gebläsemaschine Schleifmühle). Describes the gas-driven blast-furnace and steel-works blowers built by Ehrhardt & Sehmer. Ills. 2000 w. Elektrotech Rundschau—Oct. 13, 1910. No. 18901 D.

See also Gas Power Plants, under MECHANICAL ENGINEERING, Combustion Motors; and Turbo-Compressors, under MECHANICAL ENGINEERING, Power and Transmission.

Cuba.

Iron Ores of Santiago, Cuba. E. B. Wilson. Illustrated account of the location and extent of the deposits, methods of mining and transportation. 4000 w. Mines & Min—Nov., 1910. No. 18336 C.

Dry-Air Blast.

Saving in Fuel and Increase in Production through the Use of Dried and Heated Blast (Ueber die Ursachen der Brennstoffesparnis und der Mehrerzeugung beim Hochofenbetrieb durch die Verwendung erhitzten und getrockneten Windes). F Wüst. Read at the Düsseldorf Congress. A review of practical results of the Gayley process. Ills. 4200 w. Stahl u Eisen—Oct. 5, 1910. No. 18746 D.

Electrometallurgy.

Notes on the Electro-Metallurgy of Iron and Steel. T. R. Loudon. Illustrated explanation of the working of some of the furnaces used in the electro-thermic reduction of iron ore and the production of steel. 3000 w. Ap Sci—Nov., 1910. No. 18819 C.

Progress in the Electrometallurgy of Iron and Steel. James Aston. Brief review of the development and of applications made. 1500 w. Wis Engr—Nov., 1910. No. 18826 C.

A New Electric Arc Process for Producing and Refining Steel. Frank C. Perkins. Drawings and description of a new process consisting of the use of composite or combination electrodes producing arcs. 2200 w. Can Min Jour—Nov. 15, 1910. No. 18651.

The Keller Electric Steel Furnace at the F. Holtzer Steel Works, Unieux (Der Elektrostahlofen, System Keller, der Aciéries F. Holtzer in Unieux). A detailed and fully illustrated description of the installation. Serial. 1st part. 600 w. Elektrochem Zeitschr—Oct., 1910. No. 18744 D.

France.

Iron Mining in the Norman Basin (L'Extraction du Minerai de Fer dans le Bassin Normand). S. Brull. Describes mining and hoisting practice at the Larchamp mines, Orne. Ills. 2300 w. Génie Civil—Oct. 15, 1910. No. 18720 D.

Germany.

German Competition in Iron and Steel. Discusses the results of the German bounties and the effect on British exports. 1800 w. Engr, Lond—Nov. 18, 1910. No. 18996 A.

Great Britain.

Presidential Address before the West of Scotland Iron and Steel Institute, William Clark. A short review of the past and present of the iron and steel industry. 3500 w. Jour W of Scotland Ir & St Inst —Oct., 1910. No. 19006 N.

The British Steel Makers' Ore Supplies: With Some Considerations Respecting Our Future Requirements. W. H. Herdsman. Remarks on the origin of iron ores, and discussion of the low phosphorus ore supplies, the phosphorus, and the manganese ores, etc. 5500 w. Jour W of Scotland Ir & Steel Inst—Oct., 1910. No. 19005 N.

Industry.

See Germany, and Great Britain, under Iron and Steel.

Ore Resources.

The Supply of Iron. James F. Kemp. Contribution to a discussion before the Int. Geol. Cong. Discusses the world's probable reserves of iron ore. 3000 w. Mining Mag—Nov., 1910. No. 18964 B.

Rolling Mills.

Rolling Mill Machinery. Abstract translation of an article by H. Ortmann, in *Stahl und Eisen*, on the improvements made in construction during the last ten years. Ills. 2000 w. Ir Age—Nov. 10, 1910. No. 18431.

Continuous Roll Trains (Zur Frage der kontinuierlichen Walzenstrassen). E. Gerbracht. A statement of their advantages in safety and economy of operation. Ills. 2000 w. Stahl u Eisen—Oct. 19, 1910. No. 18749 D.

The Calibration of Rolls for Channel Sections (Die Anordnung der Stauchkaliber für [-Profile). L. Schaefer. A reply to a criticism of a previous paper of the author by Herr Tafel, in *Stahl und Eisen* for May 19, 1909. Ills. 2000 w. Stahl u Eisen—Oct. 26, 1910. No. 18751 D.

An Investigation of the Pressure Exerted by Blooming Rolls (Versuche über Walzdrucke an einem Blockwalzwerk). J. Puppe. A detailed report of an extended investigation by the German commission on the power requirements of rolling mills. Ills. Serial. 1st part. 6800 w. Stahl u Eisen—Oct. 26, 1910. No. 18750 D.

LEAD AND ZINC.

Australia.

Burketown Mineral Field. Lionel C. Ball. Advance report on the Queensland silver-lead and zinc mines. Ills. 5000 w. Queens Gov Min Jour—Oct. 15, 1910. No. 18673 B.

Germany.

The Silver Content of the Lead Ores of the Deutz-Ründeroth District (Der Silbergehalt der Bleierze in den Gängen des Bergreviers Deutz-Ründeroth). Eugen Schulz. Discusses the variations in the percentage of silver over a long period of years. Serial. 1st part. 5200 w. Glückauf —Oct. 1, 1910. No. 18759 D.

Lead Assaying.

Electrolytic Determination of Lead in Ores. R. C. Benner and W. H. Ross. Explanation of method, with statement of results. 1300 w. Min & Sci Pr—Nov. 12, 1910. No. 18637.

Lead Pigments.

The Manufacture of Sublimed White Lead. J. I. Blair. Illustrates and describes a process used by only two plants in the United States, producing a basic lead sulphate. 1800 w. Eng & Min Jour —Nov. 5, 1910. No. 18401.

Lead Slag.

See Slag, under Copper.

Scotland.

Lead Mining in Scotland. Editorial, giving information concerning this industry and the important developments in progress. 2200 w. Engng—Nov. 4, 1910. No. 18576 A.

Tennessee.

The Zinc Mining Industry of Tennessee. Samuel W. Osgood. Abstracted from Bul. No. 2, Tenn. Geol. Surv. Illustrated description of the zinc district, the ores, past and present methods of mining, etc. 2500 w. Min Wld—Nov. 26, 1910. No. 18960.

MINOR MINERALS.

Aluminium.

The British Aluminium Company's Works at Kinlochleven, Argyllshire. A. A. H. Scott. Remarks on the mechanical properties of aluminium, methods of working, etc., describing the industry and metallurgical practice in the West Highlands of Scotland. 2000 w. Jour Inst of San Engrs—Oct., 1910. No. 18551 B.

Calcium Sulphate.

The Reduction of Calcium Sulphate by Carbon Monoxide and Carbon, and the Oxidation of Calcium Sulphide. H. O. Hofman. Deals with the behavior of calcium sulphate under reducing conditions, and the changes the calcium sulphide formed undergoes when subjected to an oxidizing roast. 7000 w. Bul Am Inst of Min Engrs—Nov., 1910. No. 18837 F.

Cement.

The Manufacture of Portland Cement. J. Ralph Bolgiano. Illustrated description of methods and appliances used. 2000 w. Sib Jour of Engng—Oct., 1910. No. 18311 C.

Combustion in Cement Burning. Discussion of Mr. Eldred's paper. 2200 w. Bul Am Inst of Min Engrs—Nov., 1910. No. 18839 F.

Portland Cement Works in Sweden. Illustrated description of the Shanska works and the methods used. 3300 w. Engr, Lond —Oct. 28, 1910. No. 18501 A.

Monazite.

Sources and Production of Monazite and Zircon. Douglas B. Sterrett. Abstracted from Min. Resources of the U. S., 1910. Principally, information concerning monazite, which is in demand to supply thorium for the manufacture of gas mantles. 4500 w. Min Wld—Oct. 29, 1910. No. 18260.

Oil.

Occurrence of Oil and Gas. William Forstner. A study of the California deposits. 4500 w. Min & Sci Pr—Nov. 12, 1910. No. 18636.

A Review of the Oil Situation in California. A. H. Martin. Information concerning production, development, etc., giving a hopeful outlook. 1800 w. Min Wld—Nov. 5, 1910. No. 18411.

The Manufacture of Petroleum Lubricating Oils. Paul W. Prutzman. Describes the drilling and pumping of crude oil, the distillation, and refining. 2500 w. Min Wld —Oct. 29, 1910. No. 18262.

Maikop: The Position To-day. E. de Hautpick. Describes the work done and in progress in this Russian petroleum region. 3000 w. Min Jour—Nov. 5, 1910. No. 18565 A.

Platinum.

Government Monopoly of Russian Platinum Industry. E. de Hautpick. A report of the Ural platinum industry. 1000 w. Min Jour—Nov. 5, 1910. No. 18566 A.

Silicon.

The Production of Silicon Compounds (Neuerungen auf dem Gebiete der Siliciumverbindungen). S. Herrmann. Describes the Baraduc-Muller processes of producing metallic silicides and carbosilicides. Serial. 1st part. 1500 w. Elektrochem Zeitschr—Oct., 1910. No. 18743 D.

Tin.

Tin Mining and Milling in the Bolivian Andes. George W. Dean. Illustrated article describing the crude methods employed. 2000 w. Eng & Min Jour—Nov. 26, 1910. No. 18895.

Tungsten.

Occurrence of Tungsten in Rand District, Cal. Samuel H. Dolbear. Information concerning the deposits, methods employed, tests, etc. 2000 w. Eng & Min Jour—Nov. 5, 1910. No. 18400.

Zircon.

See Monazite, under MINOR MINERALS.

MINING.

Drainage.

The Cripple Creek Drainage Tunnel, Colorado. A. W. Warwick. Explains how the Roosevelt tunnel has been driven and what it is intended to accomplish. Ills. 3500 w. Min Wld—Nov. 26, 1910. No. 18958.

Earth Settlement.

Earth Settlement in Mining Districts (Beiträge zur Bergschädenfrage). Herr Fromme. A discussion of the dangers of buildings located over mine workings. Ills. 2500 w. Glückauf—Oct. 8, 1910. No. 18761 D.

Education.

See same title, under INDUSTRIAL ECONOMY.

Electric Hoisting.

Electric Hoisting in Mining Operations. S. F. Walker. Discusses the gradual replacing of the steam hoist by electric systems, giving brief descriptions of some of them. Ills. 2500 w. Eng & Min Jour—Nov. 19, 1910. No. 18657.

Explosives.

Blasting Supplies. F. H. Gunsolus. On the importance of proper apparatus for firing and detonating explosives. Ills. 3800 w. Mines & Min—Nov. 1910. No. 18333 C.

Floods.

Danger of Inrushes of Surface Water. Explains the need of thick covers above mines liable to surface floods. 1000 w. Eng & Min Jour—Nov. 12, 1910. No. 18522.

Haulage.

Haulage Gears for Mines. Illustrated description of a modern example of haulage installations. 1200 w. Engng—Nov. 18, 1910. No. 18994 A.

Hoisting Engines.

The Caledonia Cut-Off Gear for Winding Engines. Illustrated description of the gear and its action. 1500 w. Col Guard—Nov. 4, 1910. No. 18573 A.

Corliss Winding Engines. Illustrated description of engines recently erected at the Fryston Colliery. Also illustrates and describes the Notbohm-Eigemann safety apparatus for the prevention of overwinding. 1000 w. Engr, Lond—Oct. 28, 1910. No. 18506 A.

Mine Cars.

Car Coupling Devices in Use in the Mines in the Rhine-Westfalia District, Germany (Die auf den Zechen des rheinischwestfälischen Industriebezirks gebrauchlichen Vorrichtungen zur Verbindung des Förderwagen). Oskar Schulz. Describes a number of devices. Ills. 3200 w. Glückauf—Oct. 22, 1910. No. 18764 D.

Mine Locomotives.

Underground Electric Gathering Locomotives. Frank C. Perkins. Illustrates and describes the Jeffrey conductor cable reel gathering locomotive. 1500 w. Min Wld—Nov. 26, 1910. No. 18961.

Mine Tracks.

An Automatic Signal System for Crossovers on Underground Railways Operated by Electric Locomotives (Selbsttätige Signalvorrichtung zur Sicherung des Betriebes elektrischer Lokomotiven an Kreuzungstellen unter Tage). Herr Mayer. Describes an installation in a German coal mine. Ills. 1500 w. Glückauf—Oct. 15, 1910. No. 18762 D.

Mining Law.

Recent Mining Legislation in the Kingdom of Saxony (Die neuzeitliche Berggesetzgebung im Königreich Sachsen). G. Stein. Discusses particularly the sections relating to mine accidents. Serial. 1st part. 7500 w. Glückauf—Oct. 29, 1910. No. 18766 D.

Placer Mining.

The Drag Line Excavator. J. Power Hutchins. Illustrated description of this new machine and its operation, explaining its advantages in placer mining. 2000 w. Mining Mag—Nov., 1910. No. 18949 B.

Prospecting.

Prospecting Disseminated Copper Ore Deposits. Charles R. Keyes. Shows that a study of geological conditions is essential and new methods of prospecting. 2000 w. Eng & Min Jour—Nov. 26, 1910. No. 18896.

Prospecting in the Cobalt District. H L. Batten. Discusses the work to be performed after the claim is staked, to determine the value of the property, position of veins, etc. 2500 w. Ap Sci—Nov., 1910. No. 18820 C.

Prospects.

The Difference Between a Prospect and a Mine. Francis C. Nicholas. An explanation. 2500 w. Min Wld—Nov. 26, 1910. No. 18962.

Shaft Lining.

Reinforced Concrete in Mining (Eisenbeton unter Tage). F. Baumstark. The first part discusses the lining of shafts and shaft stations. Ills. Serial. 1st part. 1700 w. Beton u Eisen—Oct. 27, 1910. No. 18798 F.

Shafts.

A Concrete Shaft at Tower, Minnesota. P. F. Chamberlain. Detailed description of work on the property of the N. American Iron Mining Co., made necessary by the great amount of water. Ills. 1500 w. Eng Rec—Nov. 12, 1910. No. 18516.

Shaft Sinking.

A Study of the Freezing Process (Versuche und Studien über das Gefrierverfahren). W. Walbrecker. A detailed examination of the freezing process in shaft sinking. Ills. Serial. 1st part. 4800 w. Glückauf—Oct. 22, 1910. No. 18763 D.

Tunnels.

See Drainage, under MINING; and Tunnels, under CIVIL ENGINEERING, CONSTRUCTION

ORE DRESSING AND CONCENTRATION.

Chilean Mills.

Some of the Characteristics of Chilean Mills. Herbert A. Megraw. Explains the original purpose of the Chilean mill, the changes in modern mills and the advantages. 2500 w. Eng & Min Jour—Nov. 12, 1910. No. 18521.

Crushing.

See Rock Crushing, under CIVIL ENGINEERING, MUNICIPAL.

Electrostatic Separation.

Electrostatic Separation. Henry A. Wentworth. Explains the difference in principle between electrostatic and magnetic separation. 1500 w. Min & Sci Pr —Oct. 29, 1910. No. 18364.

Sampling.

The Element of Chance in the Sampling of Ores. Lewis T. Wright. A study of the magnitude of the element of chance in sampling ores. 4500 w. Mining Mag—Nov., 1910. No. 18948 B.

Stamp Mills.

Notes on Battery Practice. A. R. Stackpoole. Short paper on stamp mill accessories, with discussion. Ills. 3200 w. Jour Chem, Met, & Min Soc of S Africa—Sept., 1910. No. 18555 E.

Tin Milling.

See Tin, under MINOR MINERALS.

Tube Mills.

The Problem of Fine Grinding in Tube Mills. H. W. Hardinge. Discusses the inefficiency of tube mills, and some of the problems of fine crushing. 1200 w. Eng & Min Jour—Nov. 26, 1910. No. 18897.

MISCELLANY.

Argentina.

Mining in the Argentine. Charles Janin. Map and general information. 1700 w. Min & Sci Pr—Oct. 29, 1910. No. 18365.

Canada.

The Department of Mines of Canada. Its Organization and Its Work. Alfred W. G. Wilson. A statement of the present organization and functions of the department, with a brief historical sketch. 4000 w. Ec-Geol—Nov., 1910. No. 18623 D.

Colorado.

Scope and Progress of the Mining Industry in Colorado. Prepared by the Faculty of the Colorado Sch. of Mines. A review of recent development, the range of metals and minerals, etc. 10000 w. Colo Sch of Mines Qr—Oct., 1910. No. 18308 N.

Status of Mining and Smelting in Colorado. Franklin Guiterman. Address before the Denver Chamber of Commerce. The decrease in gold, silver, and lead production is considered. 2500 w. Eng & Min Jour—Nov. 19, 1910. No. 18655.

Mining and Smelting Industries in Colorado. Franklin Guiterman. Abstract of paper read before the Denver Chamber of Mines. Discusses present conditions and some causes of the decline. 2500 w. Min Wld—Nov. 19, 1910. No. 18672.

Japan.

Mineral Resources of the Japanese Empire. Dr. A. Selwyn-Brown. Reviews the present and future outlook of the mineral industries, discussing general conditions, mining law, methods and machinery, copper and gold output. Ills. 3300 w. Engineering Magazine—Dec., 1910. Serial. 1st part. No. 18941 B.

Mineralogy.

Guide to the "Sight" Recognition" of Seventy Important Minerals. A. J. Moses. Aims to give information that will aid in identification. 9000 w. Sch of Mines Qr—July, 1910. No. 18626 D.

Nicaragua.

Promising Mining Conditions in Nicaragua. T. Lane Carter. Map and illustrated description of mining conditions and development. 2500 w. Min Wld—Nov. 5, 1910. No. 18409.

Ore Deposits.

Structure and Origin of the Magnetite Deposits Near Dillsburg, York County, Pennsylvania. E. C. Harder. Maps and description of the ore deposits and mines, the rocks, and minerals. 7000 w. Ec-Geol—Nov., 1910. No. 18622 D.

RAILWAY ENGINEERING.

CONDUCTING TRANSPORTATION.

Communication.

See Radiotelegraphy, under ELECTRICAL ENGINEERING, COMMUNICATION.

Signalling.

The Safety of Railway Trains (Die Mitwirkung des Eisenbahnzuges zu seiner Sicherung). Herr Bardtke. A review of automatic signalling apparatus. Ills. Serial. 1st part. 6000 w. Glasers Ann—Oct. 15, 1910. No. 18782 D.

New Railway Safety Apparatus (Neue Apparate zur Sicherung des Bahnbetriebes). A. Tobler. Describes a new electric signalling installation at Locle station on the Jura-Neuchâtel line. Ills. 3600 w. Schweiz Bau—Oct. 1, 1910. No. 18769 B.

The Application of Interlocking to the Lartigue Electric Semaphore (L'Application des Enclenchements de Continuité à l'Electro-Sémaphore Lartigue). Ch. Jullien. Describes the original Lartigue apparatus and the modifications which have been recently introduced. Ills. 4000 w. Rev Gen d Chemins de Fer—Oct., 1910. No. 18707 G.

MOTIVE POWER AND EQUIPMENT.

Air Brakes.

Calculating Air Pressures. Deals with calculations to determine approximately the amount of free air required to charge a reservoir to different gauge pressures, and various variations of pressure. 2500 w. Ry & Loc Engng—Nov., 1910. No. 18319 C.

Car Oscillations.

The Oscillations of a Beam on Spring Supports and Their Application to the Investigation of Railway Rolling Stock (Die Schwingungsgleichungen des Balkens auf federnden Stützen und ihre Anwendung auf die Untersuchung von Fahrzeugen). J. Jahn. A mathematical study of car and locomotive oscillations based on a study of beams on spring supports. Ills. Serial. 1st part. 7800 w. Glasers Ann—Oct. 1, 1910. No. 18781 D.

Car Painting.

Protection of Metal Equipment. William Marshall. Introductory paper and general discussion giving much information on this subject. 20000 w. Pro N Y R R Club—Oct. 21, 1910. No. 18668.

Car Painting.

Car Trucks with Tapered Plate Centering Springs on the Midi Railway (Note sur les Bogies de Voitures à Ressorts de Rappel à Lames étagées de la Compagnie de la Chemins de Fer du Midi). M. Bachellery. Brief description with detailed drawings. 1200 w. Rev Gen d Chemins de Fer—Oct., 1910. No. 18708 G.

Electrification.

Boston Electrification Problem. Abstract of the reports of the N. Y., N. H., & H. R. R. and of the B. & A. R. R. relating to the electrification of all steam railroads within the Boston district. 3500 w. Elec Ry Jour—Nov. 19, 1910. No. 18635.

Locomotive Boilers.

Locomotive Boilers. Review of reports presented at the railway congress which show a lack of uniformity in practice. 5000 w. Am Engr & R R Jour—Nov., 1910. No. 18423 C.

Experimental Investigation of Inequalities of Expansion in Locomotive Boilers. An illustrated account of experiments made on the New York Central railroad to discover the cause of cracked plates and broken staybolts. From an address by D. R. MacBain before the N. Y. R. R. Club. 2500 w. Eng News—Nov. 3, 1910. No. 18350.

Locomotive Design.

A Note on Locomotive Design (Beitrag zur Berechnung von Lokomotiven). Rud. Engel. Describes simple graphical methods for certain fundamental calculations. Ills. 2000 w. Zeitschr d Ver Deutscher Ing—Oct. 22, 1910. No. 18927 D.

Locomotive Disconnecting.

Observations on Disconnecting. F. P. Roesch. A critical discussion of locomotive disconnecting practice. 2200 w. Ry & Loc Engng—Nov., 1910. No. 18318 C.

Locomotive Fireboxes.

Overheating and Pressure Test of a Jacobs-Shupert Locomotive Firebox. Reports a test made by the A., T. & S. F. Ry. to determine the strength and behavior under severe conditions. Ills. 1400 w. Eng News—Nov. 3, 1910. No. 18352.

Test of Jacobs-Shupert Firebox. Report of test made by the Santa Fe, at Topeka, Kan. on Sept. 26, 1910. Ills. 2500 w. Ry Age Gaz—Nov. 18, 1910. No. 18642.

New Locomotive Water-Tube Fire-Box. Drawings and information concerning a water-tube fire-box on a locomotive in service on the Chemen de Fer du Nord, and its performance. 1000 w. Engr, Lond—Nov. 4, 1910. No. 18582 A.

Locomotive Injectors.

Injectors. Their Defects and Remedies. Editorial letter, calling attention to injector troubles found in the lifting type of injector. 1100 w. Ry & Loc Engng—Nov., 1910. No. 18317 C.

Locomotives.

The Standardization of Locomotives in India, 1910. Cyril Hitchcock. Reviews the progress of locomotive standardization in India, noting features of the design, and materials employed. Ills. 5500 w. Inst of Mech Engrs—Oct. 21, 1910. No. 18490 N.

Steam Locomotives at the Brussels Exposition (Le Locomotive a Vapore all' Esposizione internazionale di Bruxelles 1910). I. Valenziani. A detailed review of the exhibits. Ills. Serial. 1st part. 5600 w. Ing Ferro—Oct. 1, 1910. No. 18737 D.

French Locomotives at the Brussels Exposition (Les Locomotives françaises a l'Exposition de Bruxelles). Brief descriptions of the various types exhibited, with plates and detailed drawings. Ills. Serial. 1st part. 2200 w. Rev Indus—Oct. 15, 1910. No. 18717 D.

Converted Mallet Locomotives for the Chicago Great Western. Illustrated detailed description of locomotives converted from the Prairie type to Mallet compounds. 1000 w. Ry Age Gaz—Nov. 4, 1910. No. 18372.

Mallet Articulated Compound Locomotive of the 2-8-8-2 Type. Illustrated description of an engine for the Virginian Ry., guaranteed to haul 20 cars weighing 28 tons each, with a caboose, up a 2.07 per cent. grade. 600 w. Am Engr & R R Jour—Nov., 1910. No. 18424 C.

Mallet Compound Locomotives for the Chesapeake & Ohio Ry. Illustrated description of a type of locomotive for heavy freight service. One of 24 engines ordered. 1400 w. Ry & Engng Rev—Nov. 5, 1910. No. 18437.

Engines for the St. Louis South-Western. Illustrates and describes engines of the 4-6-0 and 2-0-8 types, fitted with Walschaerts valve gear. 1200 w. Ry & Loc Engng—Nov., 1910. No. 18316 C.

Pacific and Consolidation Type Locomotives. Illustrates and describes powerful freight and passenger locomotives designed and built by the Chicago, Milwaukee & St. Paul Ry. 1200 w. Am Engr & R R Jour—Nov., 1910. No. 18429 C.

Suburban Tank Locomotive 4-6-4 Type. Illustrated description of an engine designed and built by the Canadian Pacific Ry. 2000 w. Am Engr & R R Jour—Nov., 1910. No. 18427 C.

Locomotive Stokers.

Mechanical Stokers for Locomotives. S. L. Yerkes. Brief consideration of the various types, followed by general discussion. 9000 w. Pro So & S-W Ry Club Sept., 1910. No. 18695 D.

Locomotive Valve Gears.

The Improved Baker-Pilliod Valve Gear. Illustrated detailed description. 1500 w. Am Engr & R R Jour—Nov., 1910. No. 18428 C.

Motor Cars.

See Oil Engines, under MECHANICAL ENGINEERING, COMBUSTION MOTORS.

Train Lighting.

Electric Car Lighting. D. F. Crawford. Brief consideration of the various systems, the recent development, and their applicability to the conditions to be met. 4500 w. Yale Sci M—Nov., 1910. No. 18627 C.

NEW PROJECTS.

Grand Trunk Pacific.

The National Trans-Continental Railway of Canada. Information concerning the railway under construction to connect the Atlantic and Pacific, which is entirely on British territory. A review of recent progress. 1200 w. Engr, Lond—Nov. 4, 1910. No. 18580 A.

Idaho & Washington.

The Idaho & Washington Northern. Map and illustrated description of a line through valuable timber lands and mining districts of the far west. 2000 w. Ry Age Gaz—Nov. 18, 1910. No. 18641.

PERMANENT WAY AND BUILDINGS.

Embankment Protection.

Methods of Bank Protection. Report of a committee to the Am. Ry. Bridge & Bldg. Assn. Illustrates and describes methods to meet various conditions. 2500 w. Ry & Engng Rev—Nov. 5, 1910. No. 18436.

Logging Railways.

See Narrow Gauge, under PERMANENT WAY AND BUILDINGS.

Material Storage.

The New Material Storage Yard of the Holland Railway Company at Hilversum (De nieuwe Stapelplaatsen en houtbereidings-inrichting "Crailoo" van de Hollandsche IJzeren Spoorweg-Maatschappij te Hilversum). H. P. Maas Geesteranus. Describes a plant for the storage and handling of ties, rails, etc. Ils. 4600 w. De Ingenieur—Oct. 15, 1910. No. 18933 D.

Narrow Gauge.

The Logging Railways of the Pacific Northwest. Illustrates and describes railways built to bring timber out of the forests, and their equipment. 1500 w. Ry Age Gaz—Nov. 4, 1910. No. 18369.

Oil Houses.

Fireproof Oilhouses. Report of a committee to the Am. Ry. Bridge & Building Assn. on plans of fireproof oilhouses for storing large quantities of oil. Ils. 2000 w. Ry & Engng Rev—Oct. 29, 1910. No. 18264.

Ties.

Steel Ties and Wood Ties (Eisenschwelle und Holzschwelle). A summary of the controversy being waged in Germany over the relative merits of the two materials. 11200 w. Stahl u Eisen—Oct. 5, 1910. No. 18745 D.

Yards.

Gravity Freight Classification Yard for the Pennsylvania R. R. at Northumberland, Pa. W. A. MacCart. One of the largest freight classification yards on the Pennsylvania system operated by the hump or gravity method is illustrated and described. 2000 w. Engng News—Nov. 17, 1910. No. 18667.

TRAFFIC.

Commutation.

Rates and Cost of Commutation. Gives a chart made for the use of the N. Y., N. H. & H., discussing the information it gives. 700 w. Ry Age Gaz—Dec. 2, 1910. No. 19113.

Freight Rates.

Railway Rates and Railway Efficiency. Editorial discussion of the address by Louis T. Brandeis undertaking to show how the railways of the United States can reduce their operating expenses. 2500 w. Ry Age Gaz—Dec. 2, 1910. No. 19112.

Tonnage Charts.

Graphic Comparisons of Tonnage. F. A. Parker. Shows the usefulness of the graphic method of showing the condition of the volume and direction of business. 700 w. Ry Age Gaz—Nov. 18, 1910. No. 18643.

MISCELLANY.

England.

Transportation and Traffic in England. Logan G. McPherson. From a Preliminary Report to the Nat. Waterways Com. of the U. S. Historical review of the development. 4500 w. Ry Age Gaz—Nov. 25, 1910. Serial. 1st part. No. 18869.

Forest Fires.

Forest Fires and Railways. R. H. Campbell. Discusses fires due directly to railways, and Canadian railway acts relating to the subject. 3000 w. Can Engr —Nov. 17, 1910. No. 18652.

Great Britain.

The Earning Power of British Railways. General discussion of considerations affecting the prosperity of railways with tabulated statistics of gross and net earnings. 3800 w. Jour Soc of Arts—Oct. 21, 1910. Serial. 1st part. No. 18276 A.

International Congress.

The Significance and Results of the Eighth Session of the International Railway Congress (Ueber die Bedeutung und den Erfolg der achten Tagung des Internationalen Eisenbahn-Kongress-Verbandes). H. Dietler. A review of the work and permanent results of the recent meeting at Berne. 2200 w. Schweiz-Bau—Oct. 8, 1910. No. 18770 B.

Legislation.

The New Long and Short Haul Law. Discusses the power given to the Interstate Commerce Commission by this section of the Mann-Elkins act. 5500 w. Ry Age Gaz—Nov. 25, 1910. No. 18870.

The New "Commerce Court." Paul Synnestvedt. An explanation of the reasons for creating this court, its organization, special provisions and effect on the railroad situation generally. Discussion. 12500 w. Pro W Ry Club—Oct. 18, 1910. No. 18667 C.

Management.

Can the "Principles of Scientific Management" Be Applied to Railway Operation? Gives the substance of the address of Mr. Louis D. Brandeis before the Interstate Commerce Commission, with editorial comment. A critical discussion of the efficiency of railway operating in the United States. 2000 w. Eng News—Dec. 1, 1910. No. 19056.

See also Freight Rates, under TRAFFIC; and Wage Systems, under INDUSTRIAL ECONOMY.

STREET AND ELECTRIC RAILWAYS.

Canal Haulage.

An Electrical Towing Installation on the Weser Canal at Bremen (Die elektrische Treidelei der Wehranlage für die Unterweserkorrektion bei Bremen). Otto Tuch. Illustrated description. 1800 w. Zeitschr d Ver Deutscher Ing—Oct., 1910. No. 18926 D.

Car Houses.

Recent Car House Construction in Chicago. Abstract from report of the Board of Sup.-Engrs., Chicago Traction, on principles of design and construction. 3000 w. Elec Ry Jour—Nov. 5, 1910. No. 18361.

Car Maintenance.

Car Maintenance Practice at Waltham, Mass. Illustrated detailed description of the system. 3000 w. Elec Ry Jour—Nov. 12, 1910. No. 18464.

Feeders.

Feeder Calculations for the Chicago Street Railways. Information from the second annual report, giving resolution adopted, and outlining the system of calculating the feeder requirements. 2000 w. Elec Ry Jour—Nov. 19, 1910. No. 18634.

Locomotive Headlights.

Discussion on "Headlight Tests." Jefferson, N. H., June 28, 1910. 3500 w. Pro Am Inst of Elec Engrs—Nov., 1910. No. 18846 F.

Locomotives.

Discussion on "The Design of the Electric Locomotive." Jefferson, N. H., July 1, 1910. The paper by N. W. Storer and G. M. Eaton is discussed. 7000 w. Pro Am Inst of Elec Engrs—Nov., 1910. No. 18849 F.

New Electric Locomotives for the Baltimore & Ohio Railroad. Illustrated description of two additional locomotives for service on the Baltimore belt line of the B. & O. R. R. 1400 w. Elec Ry Jour—Nov. 26, 1910. No. 18860.

A Swiss Accumulator Locomotive. Illustrated detailed description of an engine designed to meet stated conditions which has proved efficient in service. 1200 w. Tram & Ry Wld—Nov. 3, 1910. No. 18631 B.

An Electric Locomotive for the Wengernalp Railway, Switzerland (Locomotive électrique du Chemin de Fer de la Wengernalp, Suisse). Describes a novel locomotive for a rack railway. Ills. 1000 w. Génie Civil—Oct. 15, 1910. No. 18724 D.

Monorail.

The Monorail. Brief explanation of the theory and action of such cars, and statement of advantages claimed. 1000 w. Yale Sci M—Nov., 1910. No. 18629 C.

Physical Objections to the Scherl Monorail System (Physikalische Bedenken gegen die Einschienenbahn des Herrn Scherl). O. Martienssen. A criticism of certain fundamental parts of the system. Ills. 3000 w. Elek Kraft u Bahnen—Oct. 24, 1910. No. 18906 D.

Operation.

Discussion on "Power Economy in Electric Railway Operation—Coasting Tests on the Manhattan Railway, New York." Jefferson, N. H., July 1, 1910. H. St. Clair Putnam's paper is discussed. 3300 w. Pro Am Inst of Elec Engrs—Nov., 1910. No. 18850 F.

Rail Cleaning.

The Cleaning of Tramway Rails. A. Schörling. Abstract of a report describing the various apparatus and methods used. 1400 w. Elect'n, Lond—Nov. 4, 1910. No. 18564 A.

Rails.

The Composition and Manufacture of Tramway Rails and Rail Wear. Robert B. Holt. Illustrated discussion of the relation between rail wear and the composition and manufacture of the rails. 1700 w. Tram & Ry Wld—Nov. 3, 1910. No. 18630 B.

Rio de Janeiro.

The Corcovado Railway (Die Corcovadobahn). J. G. Boesch-Ouzelet. Detailed description of this line of the Rio de Janeiro Tramway, Light & Power Co. Ills. Serial. 1st part. 5200 w. Elek Kraft u Bahnen—Oct. 14, 1910. No. 18905 D.

Shops.

Repair Shop Practice of the Portland Railroad Company. Illustrated description of electric railway repair shops at Portland, Maine, and their equipment. 2500 w. Elec Ry Jour—Nov. 26, 1910. No. 18859.

Subways.

The Triborough Subway in New York City; Statement by Chairman Willcox of the Public Service Commission. An account of the present stage of the subway developments. 2000 w. Eng News—Nov. 24, 1910. No. 18877.

A Great Subterranean Railway Junction. Interesting illustration of conditions at 42nd St. and Madison Ave., New York City, showing five distinct lines of railway, with brief notes. 1000 w. Sci Am—Nov. 19, 1910. No. 18644.

Systems.

Economic Considerations Governing the Selection of Electric Railroad Apparatus. F. Darlington. Discusses the relative merits of the three electric railroad systems from the standpoint of economy of construction and operation. Ills. General discussion. 13500 w. Jour W Soc of Engrs—Oct., 1910. No. 18833 D.

EXPLANATORY NOTE—THE ENGINEERING INDEX

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language*, together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cts. The letter A, B, or C denotes a price of 40 cts.; D, of 60 cts.; E, of 80 cts.; F, of $1.00; G, of $1.20; H, of $1.60. When the letter X is used it indicates that copies are not readily obtainable and that particulars as to price will be supplied on application. Certain journals, however, make large extra charges for back numbers. In such cases we may have to increase proportionately the normal charge given in the Index. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

Serial publications are indexed on the appearance of the first instalment.

SPECIAL NOTICE.—To avoid the inconvenience of letter-writing and small remittances, especially from foreign countries, and to cheapen the cost of articles to those who order frequently, we sell coupons at the following prices:—20 cts. each or a book of twelve for $2.00; three books for $5.00.

Each coupon will be received by us in payment for any 20-cent article catalogued in the Index. For articles of a higher price, one of these coupons will be received for each 20 cents; thus, a 40-cent article will require two coupons; a 60-cent article, three coupons; and so on. The use of these coupons is strongly commended to our readers. They not only reduce the cost of articles 25 per cent. (from 20c. to 15c.), but they need only a trial to demonstrate their very great convenience—especially to engineers in foreign countries, or away from libraries and technical club facilities.

Write for a sample coupon—free to any part of the world.

CARD INDEX.—These pages are issued separately from the Magazine, printed on one side of the paper only, and in this form they meet the exact requirements of those who desire to clip the items for card-index purposes. Thus printed they are supplied to regular subscribers of THE ENGINEERING MAGAZINE at 10 cents per month, or $1.00 a year; to non-subscribers, 25 cts. per month, or $3.00 a year.

THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *t-m*, a tri-monthly, *qr*, a quarterly, *s-q*, semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated; W—Words; Anon—Anonymous.

Alliance Industrielle. *m.* Brussels.
American Architect. *w.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Jl. of Science. *m.* New Haven, U. S. A.
American Machinist. *w.* New York.
Anales de la Soc. Cien. Argentina. *m.* Buenos Aires.
Annales des Ponts et Chaussées. *m.* Paris.
Ann. d Soc. Ing. d Arch Ital. *s-m.* Rome.
Architect. *w.* London.
Architectural Record. *m.* New York.
Architectural Review. *s-q.* Boston.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Melbourne.
Autocar. *w.* Coventry, England.
Automobile. *w.* New York.
Automotor Journal. *w.* London.
Beton und Eisen. *qr.* Vienna.
Boiler Maker. *m.* New York.
Brass World. *m.* Bridgeport, Conn.
Brickbuilder. *m.* Boston.
Builder. *w.* London.
Bull. Bur. of Standards. *qr.* Washington.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bull. of Can. Min. Inst. *qr.* Montreal.
Bull. Soc. Int. d'Electriciens. *m.* Paris.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bull. Int. Railway Congress. *m.* Brussels.
Bull. Scien. de l'Assn. des Elèves des Ecoles Spéc. *m.* Liége.
Bull. Tech. de la Suisse Romande. *s-m.* Lausanne.
California Jour. of Tech. *m.* Berkeley, Cal.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *w.* Toronto and Montreal.
Canadian Mining Journal. *b-w.* Toronto.
Cassier's Magazine. *m.* New York and London.
Castings. *m.* Cleveland, O.
Cement. *m.* New York.
Cement Age. *m.* New York.
Central Station. *m.* New York.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Colliery Guardian. *w.* London.
Commercial Vehicle. *m.* New York.

Compressed Air. *m.* New York.
Cornell Civil Engineer. *m.* Ithaca.
Deutsche Bauzeitung. *b-w.* Berlin.
Die Turbine. *s-m.* Berlin.
Domestic Engineering. *w.* Chicago.
Economic Geology. *m.* New Haven, Conn.
Electrical Age. *m.* New York.
Electrical Engineer. *w.* London.
Electrical Engineering. *w.* London.
Elec. Review and W. Elec'n. *w.* Chicago.
Electrical Review. *w.* London.
Electric Journal. *m.* Pittsburg, Pa.
Electric Railway Journal. *w.* New York.
Electrical World. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.
Elektrische Kraftbetriebe u Bahnen. *w.* Munich.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnik u Maschinenbau. *w.* Vienna.
Elektrotechnische Rundschau. *w.* Potsdam.
Elettricità. *w.* Milan.
Engineer. *w.* London.
Engineering. *w.* London.
Engineering-Contracting. *w.* New York.
Engineering Magazine. *m.* New York and London.
Engineering and Mining Journal. *w.* New York.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penna. *m.* Pittsburg, U. S. A.
Far Eastern Review. *m.* Manila.
Foundry. *m.* Cleveland, U. S. A.
Génie Civil. *w.* Paris.
Giesserei-Zeitung. *s-m.* Berlin.
Glasers Ann. f Gewerbe & Bauwesen. *s-m.* Berlin.
Heating and Ventilating Mag. *m.* New York.
Horseless Age. *w.* New York.
Ice and Cold Storage. *m.* London.
Ice and Refrigeration. *m.* New York.
Il Cemento. *s-m.* Milan.
Industrial World. *w.* Pittsburg.
Ingegneria Ferroviaria. *s-m.* Rome.
Ingenieur. *w.* Hague.
Insurance Engineering. *m.* New York.
Int. Marine Engineering. *m.* New York.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron Trade Review. *w.* Cleveland, U. S. A.
Jour. of Accountancy. *m.* N. Y.
Journal Am. Soc. of Engineering-Contractors. *m.* New York.
Journal Asso. Eng. Societies. *m.* Philadelphia.
Journal Franklin Institute. *m.* Philadelphia.
Jour. N. E. Water Works Assn. *qr.* Boston.
Journal Royal Inst. of Brit. Arch. *s-q.* London.
Jour. Roy. United Service Inst. *m.* London.
Journal of Sanitary Institute. *qr.* London.
Jour. of South African Assn. of Engineers. *m.* Johannesburg, S. A.
Journal of the Society of Arts. *w.* London.
Jour. Transvaal Inst. of Mech. Engrs., Johannesburg, S. A.
Jour. of U. S. Artillery. *b-m.* Fort Monroe, U. S. A
Jour. W. of Scot. Iron & Steel Inst. *m.* Glasgow.
Journal Western Soc. of Eng. *b-m.* Chicago.
Jour. of Worcester Poly. Inst., Worcester, U. S. A.
Locomotive. *m.* Hartford, U. S. A.
Machinery. *m.* New York.
Manufacturer's Record. *w.* Baltimore.
Marine Review. *m.* Cleveland, U. S. A.
Mechanical Engineer. *w.* London.
Mechanical World. *w.* Manchester.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Metallurgical and Chem. Engng. *m.* New York.
Métallurgie. *w.* Paris.
Metal Worker. *w.* New York.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci. Press. *w.* San Francisco.
Mining Journal. *w.* London.
Mining Magazine. *m.* London.
Mining World. *w.* Chicago.
Mittheilungen des Vereins für die Förderung des Local- und Strassenbahnwesens. *m.* Vienna.
Municipal Engineering. *m.* Indianapolis, U. S. A.
Municipal Journal and Engineer. *w.* New York.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Oest. Wochensch. f. d. Oeff. Baudienst. *w.* Vienna.
Oest. Zeitschr. Berg- & Hüttenwesen. *w.* Vienna.
Power and The Engineer. *w.* New York.
Practical Engineer. *w.* London.
Pro. Am. Ins. Electrical Eng. *m.* New York.
Pro. Am. Ins. of Mining Eng. *m.* New York.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Pro. Am. Soc. Mech. Engineers. *m.* New York.
Pro. Canadian Soc. Civ. Engrs. *m.* Montreal.
Proceedings Engineers' Club. *qr.* Philadelphia.
Pro. Engrs. Soc. of Western Pennsylvania. *m.* Pittsburg.
Pro. St. Louis R'way Club. *m.* St. Louis, U. S. A.
Pro. U. S. Naval Inst. *qr.* Annapolis, Md.
Progressive Age. *s-m.* New York.
Public Works. *qr.* London.
Quarry. *m.* London.
Queensland Gov. Mining Jour. *m.* Brisbane, Australia.
Railway Age Gazette. *m.* New York.
Railway and Engineering Review. *w.* Chicago.
Railway and Loc. Engng. *m.* New York.
Railway Master Mechanic. *m.* Chicago.
Revue d'Electrochimie et d'Electrométallurgie. *m.* Paris.
Revue de Mécanique. *m.* Paris.
Revue de Métallurgie. *m.* Paris.
Revue Gén. des Chemins de Fer. *m.* Paris.
Revue Gén. des Sciences. *w.* Paris.
Revue Industrielle. *w.* Paris.
Rivista Marittima. *m.* Rome.
Rudder. *m.* New York.
Schiffbau. *s-m.* Berlin.
School of Mines Quarterly. *q.* New York.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Sibley Jour. of Mech. Eng. *m.* Ithaca, N. Y.
Signal Engineer. *m.* Chicago.
Soc. Belge des Elect'ns. *m.* Brussels.
Stahl und Eisen. *w.* Düsseldorf.
Stevens Institute Indicator. *qr.* Hoboken, U. S. A.
Surveyor. *w.* London.
Technique Moderne. *m.* Paris.
Tramway & Railway World. *m.* London.
Trans. Inst. of Engrs. & Shipbuilders in Scotland, Glasgow.
Wood Craft. *m.* Cleveland, U. S. A.
Yale Scientific Monthly. *m.* New Haven.
Zeitschr. f. d. Gesamte Turbinenwesen. *w.* Munich.
Zeitschr. d. Mitteleurop. Motorwagen. Ver. *s-m.* Berlin.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschr. f. Werkzeugmaschinen. *b-w.* Berlin.

CURRENT RECORD OF NEW BOOKS

NOTE—*Our readers may order through us any book here mentioned, remitting the publisher's price as given in each notice. Checks, Drafts, and Post Office Orders, home and foreign, should be made payable to* THE ENGINEERING MAGAZINE.

Economic Geology.

Economic Geology, with Special Reference to the United States. By Heinrich Ries. Size, 9 by 6 in.; pp. XXXIII, 589. Ills. Price, $3.50. New York: The Macmillan Company.

A new edition of this standard work required but little introduction. In the four years since it first appeared it has attained a foremost place as a textbook and as a book of reference. Prof. Ries' revision has extended to all parts of the work. Much matter of a general character, dealing with the principles of the subject, has been added, and certain additional individual occurrences have been described. The statistical part also has been brought fully up to date.

Internal-Combustion Engines.

The Construction and Working of Internal-Combustion Engines. By R. E. Mathot. Translated from the French by W. A. Tookey. Size, 9½ by 6 in.; pp., XXII, 554. Ills. Price, $6. New York: D. Van Nostrand Company.

M. Mathot is, to English and American engineers, probably the best known of the Continental specialists in gas-power machinery. His papers before the British and American engineering societies of which he is a member, his frequent contributions to the technical press, and his earlier book on the gas engine and gas producer, which won such flattering recognition from Mr. Dugald Clerk, have served to introduce him to a large number of engineers who will welcome the appearance of his latest work.

The present book was originally published in Paris in 1907. The translator, however, at the author's express request, has fully revised the work to meet the requirements of English and American engineers, and has brought it fully up to date. M. Mathot's treatment is descriptive rather than theoretical. The first section, of three chapters, deals with the progress and future of gas power, and the relative merits of gas and steam engines. Part II, which takes up over 300 pages, discusses construction and design, and enters into full descriptions of the various types of gas engines and of their mechanical details. The third section considers questions of power and efficiency, testing and testing apparatus, indicator diagrams, etc., while a bibliography of the subject and a list of gas-engine and gas-producer makers are given in appendices. The large number of very clear illustrations is a feature of the book, and a full index adds greatly to its convenience as a work of reference.

Iron and Steel.

Iron and Steel—A Pocket Encyclopedia. By Hugh P. Tiemann. Size, 7 by 4 in.; pp., 354. Ills. Price, $3. New York and London: McGraw-Hill Book Company.

Henry M. Howe says in a brief introduction to this comprehensive dictionary of iron and steel metallurgical terms: "The gallant author comes to the aid of the fumbling metallographist and irritated millman. With infinite pains, ingenuity and skill he blesses both where they had banned each other, and enables the brothers to dwell together in harmony, unfolding to each the jargon of the other by means of a tri-lingual dictionary, translating the jargons of both into the common language, English. Nor are they alone his debtors. Having long lived a metallographist and a teacher among the millmen he discloses clearly, tersely, and graphically the manners and customs of the millmen, to wit, the how and the why of their actual practice, as only a resident can know it. In short, he describes the actual metallurgical operations and apparatus in a way which seems to me most admirable." With Dr. Howe's opinion we are heartily in accord, and we have no hesitation in commending Mr. Tiemann's book as an extremely handy compendium of iron and steel works processes, practice, and apparatus.

IMPROVED MACHINERY

NEW METHODS
NEW PROCESSES
NEW MATERIALS
NEW APPLIANCES

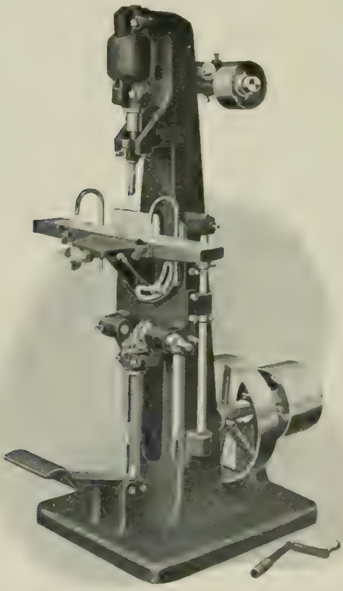
Intelligent Publicity.

—Mr. George H. Jones, Vice-Presient of the Inland Steel Company, Chicago, enjoys the distinction of being the first steel manufacturer to demonstrate, conclusively, the effective value of intelligent publicity in marketing a strictly staple product of iron and steel. Manufacturers of machinery of every kind long ago discovered the invaluable service which the engineering press can render in making known the merits and performances of special and standard types of machinery, but in the iron and steel trade, advertising has always been accounted a useless waste of money. And Mr. Jones is the first man to conclusively demonstrate the contrary.

Sharing in the phenomenal prosperity which preceded the panic of 1907, the Inland Steel Company found it necessary, not only to enlarge and perfect their equipment for handling every stage of their product, from the ore to finished sheet, but also to increase their sheet capacity by full 80 per cent. Just after this new and extensive enlargement of their works had been completed, the heavy slump in the iron and steel trade came on, and they were confronted with what promised to be a prolonged period of dull trade and price-cutting warfare among sheet-steel manufacturers. Having brought their equipment to the highest standard of efficiency, and knowing their product to be the best that could be made, Mr. Jones took the position that Inland sheets would undoubtedly command a full and fair market price—provided their merits were made known in the trade, and their quality absolutely guaranteed. Winning over his associates to this view of the situation, he secured an advertising appropriation large enough to cover full-page spaces in all the leading engineering, construction, and iron and steel journals, and he engaged Mr. R. R. Shuman, formerly of the *Iron Age* staff, to write the story of Inland sheets in a beautiful illustrated pamphlet, 34 pages, of which 10,000 copies were published. Then for a full year past, week after week and month after month—always in full pages and often in double-page advertisements—Mr. Shuman has been telling a pithy, pointed, and thoroughly interesting story of Inland sheets, which it has been a pleasure and an inspiration to read. And what is the result? The Inland Steel works have been running full time at full capacity, in spite of the dull trade of which all other leading manufacturers have been complaining; the largest jobbers in the middle west and south—indeed, from every part of the country—frankly state that they find it necessary to carry Inland sheets in stock, because of the constant and insistent demand for them from customers; and the most significant and gratifying feature of the experiment is the fact that the guarantee of quality, pledged in the published advertisements, has enabled the Inland Company *to maintain its price,* hold its customers, and gain new ones, in spite of continuous price-cutting competition.

Vertical Hollow Chisel Mortiser.

THE accompanying illustration shows a vertical hollow chisel mortiser manufactured by J. A. Fay & Egan Co. This machine will mortise to a depth of 3 inches, or by reversing the stock, it will mortise through 6 inches. It accommodates chisels from ¼ to ¾ inches square. The frame is a single piece casting with good floor support, and is perfectly rigid. The table is 4½ inches wide and 30 inches long and is moved by foot power a distance of 6 inches. It is provided with clamps to hold the stock, and angles 40 degrees in either direction. It is adjusted up and down by crank and bevel gears, is gibbed to the column of the machine and is provided with stop rod to regulate depth of mortise. The chisel mandrel is made of the best grade of crucible steel and runs in self-oiling bearings lined with genuine babbit.



VERTICAL HOLLOW CHISEL MORTISER.

For further information concerning this new tool, write to the manufacturers for large illustrated circular. Their address is 212-232 West Front street, Cincinnati, Ohio.

"Baird" Reels.

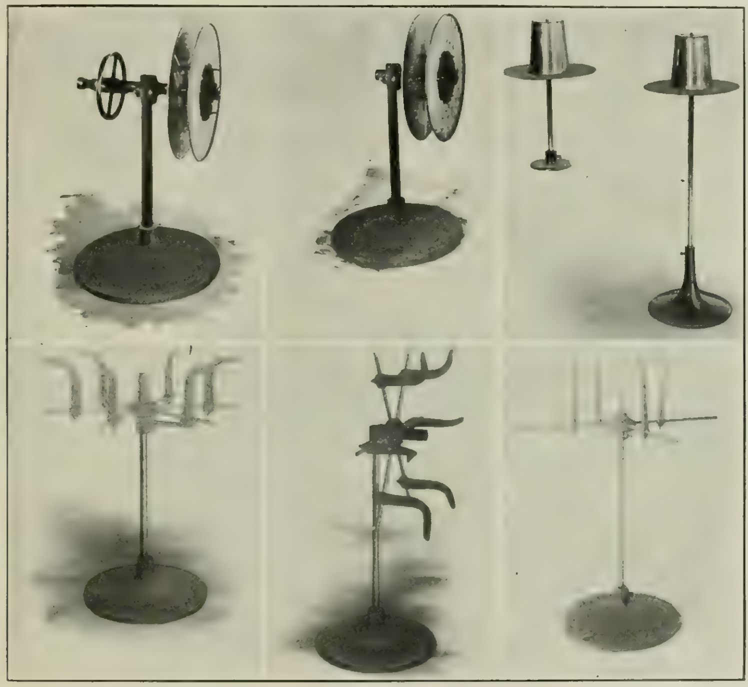
THE illustrations herewith show the wire reels used in standard and automatic wire forming machines, and the sheet metal reels most generally used in presses. These reels are furnished with Baird presses, but in smaller form and attached directly to the press.

Referring to the sheet metal and scrap reels, in the upper row, it will be seen that the pins which receive the coil of metal are adjustable so that coils of varying inside diameter can very easily and quickly be accommodated. The outer flange is also adjustable for width of metal, being held in place by a thumb screw. Furthermore, the reels are interchangeable on the stud or shaft, so that in case metal is required to be run through the press again, the reel from the scrap reel with the metal in it can be put on the scrap reel and the empty reel from the metal reel put on the scrap reel, thus saving considerable time and labor. The flanges are made of varying diameters to suit requirements, and have two radial slots through them to allow of the binding wire being cut from a new coil after the coil is placed on the reel, and also allows the operator to bind a coil of scrap metal before taking it off the reel, thus, in both cases, doing away with the very awkward handling of a loose coil, and also does away with the metal coil opening up about the room. The shaft bracket is also adjustable on the stand, giving variable heights, and the base is heavy, making the reel very rigid, not requiring it to be secured to the floor.

The drum reels here shown are used for the smaller machines and can be mounted on benches when manufacturing small springs, garment eyes, etc., and the drum reel with floor base is used with the smaller type of standard automatic machine.

The adjustable arm reel shown, besides covering a wide range, is improved by having the ends of the fingers turned inward so as to catch the loose inner coils of wire and force them into place as the coil of wire is dropped on to the reel, thus doing away with the loss of time caused by the use of the old finger reel, which would catch into the loose coils. Another photograph shows the universal arm reel, which also possesses this feature and which can be used in a vertical or horizontal position. These reels are also provided with heavy floor bases so that it is not necessary to fasten them unless desired.

Full information can be obtained from the builder, the Baird Machine Company, Oakville, Conn.

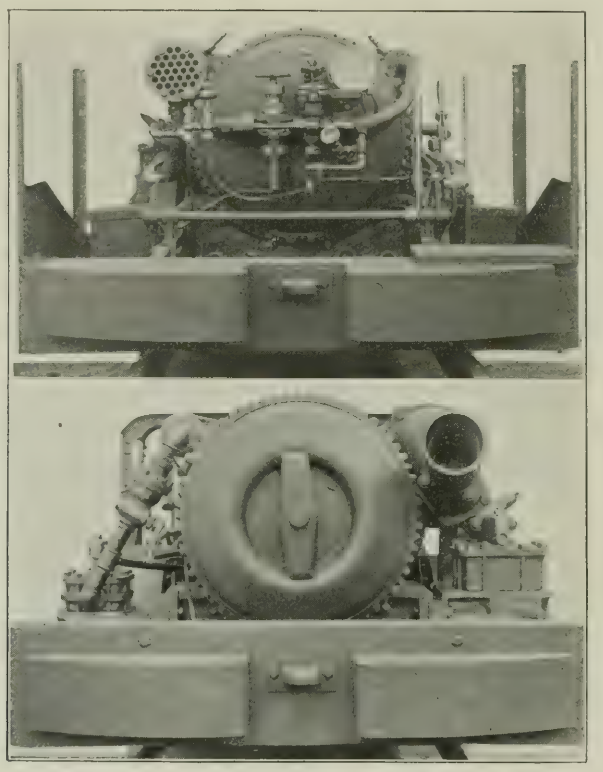


"BAIRD" REELS.

Two-Stage Compressed Air Locomotives.

IN the past thirty years, single-expansion compressed air locomotives have been operated, in gradually increasing numbers, in mines and over industrial railways. The cost of the compressor, pipe lines and charging stations, together with the cost of power to operate the compressor, all of which were usually somewhat in excess of the cost of equivalent items for other forms of locomotives, limited their use to industries and localities where a locomotive that operated without smoke, fire, sparks or wires was of the first importance.

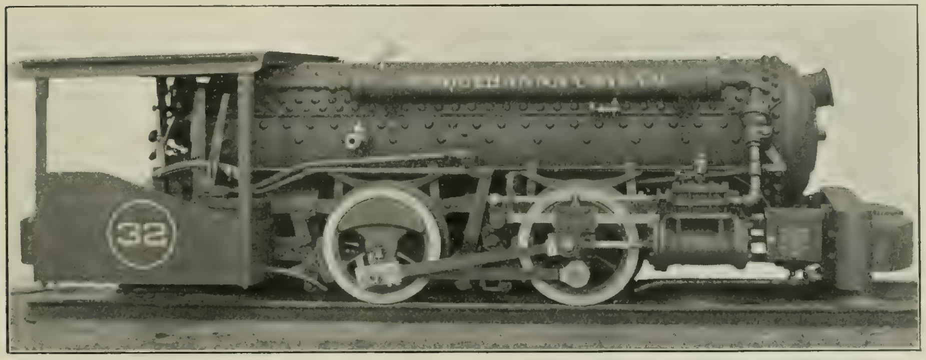
The first two-stage compressed air locomotive was used in a mine of the Susquehanna Coal Company at Nanticoke, Pennsylvania. Before any tests were made the men running it reported that "it was saving lots of air," and later, comparative tests made by hauling the same cars the same distance, over the same piece of track, alternately with the two-stage and then with a single-expansion locomotive of equal capacity, demonstrated that for six separate trips, with variable loads, the average air consumption of the two-stage was 56 per cent. of that of the single-expansion locomotive. The increased efficiency was obtained by expanding the compressed air in two successive cylinders, in connection with atmospheric interheating during the process of expansion.



PORTER TWO-STAGE COMPRESSED AIR LOCOMOTIVE.

This locomotive is shown in three views. The air is stored, at a pressure of eight or nine hundred pounds, in the large cylindrical reservoir, which may be recharged in two minutes from a stationary storage. The air reaches the high-pressure cylinder through a regulating valve, at 250 pounds pressure and atmospheric temperature. From this cylinder it exhausts through an atmospheric interheater, at a pressure of 50 pounds, to the low-pressure cylinder.

On account of the work done in the high-pressure cylinder (about 20,000 foot-pounds per pound of air), the temperature of the air leaving the high-pressure cylinder is about 140 degrees Fahrenheit below that of the atmosphere, rendering the surrounding air an efficient heating medium, which may be readily utilized by means of the interheating cylindrical reservoir filled with small tubes, through which the atmospheric air is rapidly drawn by the ejector action of the exhaust from the low-pressure cylinder. In this apparatus nearly all of the heat lost in the high-pressure cylinder is restored, expanding the air about 36 per cent., and permitting higher initial and lower terminal pressures, with a wider range of expansion—the essential features of economical operation, practically impossible in connection with the single-expansion locomotive, on account of unmanageable refrigeration.



PORTER TWO-STAGE COMPRESSED AIR LOCOMOTIVE.

Since the first locomotive of this type was built, about one hundred more have been put in operation in mines, lumber yards and other industrial establishments. Many of these installations would have been commercially impossible with the single-expansion locomotive, on account of the cost of the compressors, boiler and pipe lines; or because the power to operate the compressor cost too much; or because the locomotive had to be charged too frequently.

The two-stage locomotive has passed through the initial stage of its development, and offers today every desirable attribute of the single-expansion compressed air locomotive, at a considerable reduction in first cost and operating expenses.

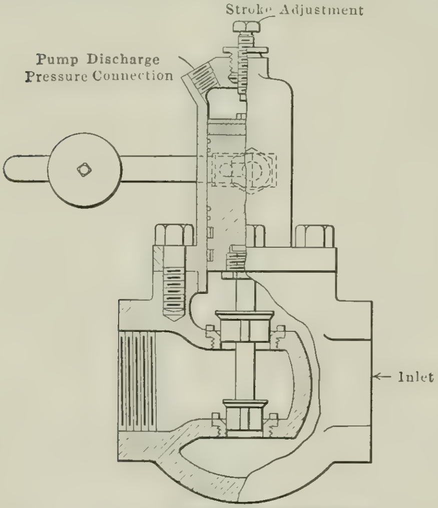
The locomotives described above are made by H. K. Porter Company, Pittsburg, Pa., who will send full details on application.

Record Concrete Laying at Gatun Locks.

ALL hourly records for concrete laying were broken on October 6, 1910, by the cableways used in constructing the great locks on the Panama Canal at Gatun. Two million cubic yards of concrete are to be used in building these locks. Lidgerwood cableways are used for placing the concrete. These cableways are aranged in duplex form on four pairs of towers. The pair of cableways which broke the record are known officially as "Strand A" and "Strand B" of Cableway No. 1. Strand A placed forty-nine cubic yards in one hour, and Strand B placed fifty cubic yards during the same hour. This means that the carriage on each Strand made twenty-five trips per hour. The cableways were sold under a guarantee that they would make twenty trips per hour. These cableways are arranged to give higher carriage speed than was ever attempted before for this class of work. This speed is rendered possible by important improvements made by Mr. Spencer Miller in anticipation of just such needs. With these improvements it is possible to use carriage speeds up to 2,500 feet per minute as against speeds of 800 or 900 feet per minute, which were as great as were before practicable. The cableways each have a span of 800 feet between towers. They are actuated by electricity and the control is as easy and simple and of the same character as the control of an up-to-date electric train. One operator controls the entire operation on each strand.

Gould Differential Governing Valve.

THE Gould differential governing valve admits steam from the closed end of the valve and the steam acts direct on the bottom of piston, the discharge pressure from the pump being connected to top of piston. By weight adjustment, a constant discharge pressure at any desired point in excess over steam pressure is secured. This operation is maintained at all times, regardless of the fluctuation of steam pressure giving constant difference of pressure without variation or adjustment. If the reverse pressure is desired—less discharge pressure than the steam pressure—the weight lever is reversed and adjustment made so that any desired discharge pressure less than the steam pressure is maintained.



GOULD DIFFERENTIAL GOVERNING VALVE.

The governor is constructed in a manner which does not employ the use of valve stem, valve stem stuffing box, springs, diaphragms or leather cups. The valve and valve seats are made of nickel alloy, and are removable. The piston is constructed of nickel alloy, the cylinder of steam bronze. All valve bodies up to and including 2 inch size are of bronze; in larger sizes than 2 inch, iron bodies are furnished. Governors are furnished either straight-way or angle type, screwed ends up to and including 2 inches, flanged on larger sizes.

This governing valve will operate on any steam pressure. The same differential pressure is maintained at all times regardless of fluctuation of steam pressure, and the same governor can be adjusted to operate for any purpose where a steam pump governor is used. The governor is the most sensitive variation of any governor ever constructed.

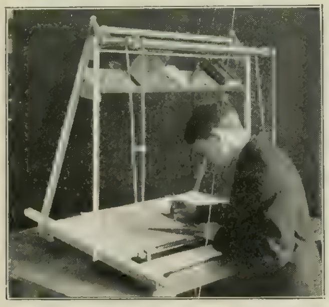
Fuller information respecting the Gould differential governing valve will be furnished on application to the maker, Safety Equipment Mfg. Co., 181-183 Van Buren street, Chicago, Ill.

Kelsey Drafting Rig.

THE Kelsey "Economic" drafting rig or lifting swing blade is a practical time saving device that arose from difficulties with long T squares and various forms of parallel blades. Its essential feature is a balanced swing, hung from a rocker, above the draftman's head, and attached at each end of a vieling blade by jointed connection with a long finger bar, over the latter. In most recent form the swing supports are castings, open at the bottom to permit long tracings to extend beyond the ends of the drawing board, and rapidly sloping away to the rear and top. The swing arms are also curved backward for greater freedom of space.

A skeleton frame at the bottom, with clamps, receives drawing boards without fittings on the latter, and the whole is intended to fasten on any substantial table; or, the swing may be hung from below in a table of special design. Connections with the finger bar permit the blade to accommodate considerable unevenness of the board without disturbing the parallelism. Advantages of the device are its ease of operation and reliability.

Its substantial connections, practically unaffected by wear, the convenient position of the finger bar and the free lift of the blade over obstructions, or its stable position a few inches above as well as on the drawing, make it an economic device in the use of time and mental tension in the operation of blades of 42 inches length or over.



"ECONOMIC" DRAFTING RIG.

Vertical and angular lining, limited as much of it is to short lengths, is most rapidly accomplished with light squares against a fixed horizontal blade. Various forms of these having steel scales with depressed edges and knobs for easy control have been devised in connection with the drafting rig and add much to its efficiency. Descriptive matter will be sent on application to D. J. Kelsey, New Haven, Conn.

Power and Babbitt Metals.

IN figuring on the problems in connection with power transmission no economical plan can very well be carried out unless careful consideration is given to the character and quality of the babbitt metal used in the bearings as a means of minimizing the loss of power due to frictional resistance. The first and most vital matter to decide is whether or not it is wise to use a cheap or ordinary grade of babbitt metal because of the initial saving in cost, or whether it is preferable to apply a high-grade anti-friction metal to all of the bearings in a plant. It is true that some bearings are less trying on a metal than other bearings, and for that reason it is often thought that any cheap grade of metal is good enough for such bearings; but is it true economy to do this? The cost of the babbitt metal itself used in an ordinary size bearing is usually infinitesimal as compared with the cost of labor in applying it. The frictional resistance from the use of a low or ordinary grade metal is waste of power that is reflected back to the boiler in causing a greater consumption of fuel. Such bearings are also liable to run hot and have to be kept flooded with oil, and the wear on the shaft and the bearing is much more rapid. It is very doubtful if these low grade metals have any economic value to the consumer of babbitt. This matter has been threshed out time and again by large manufacturing plants who have found great economy in the use of high-grade metals, effecting in some instances a saving of

33⅓ per cent in fuel, 75 per cent in the consumption of metal and 60 per cent in oil. Of course, such high percentages could not be expected in every case, but are symptomatic, as showing the possible savings to be effected by the use of a high-grade anti-friction metal. Experience has shown that these same bearings, lined with high-grade metals, will usually run from ten to twenty times as long as the ordinary grades and thereby reduce the cost for labor in rebabbitting to an extent that amounts to a considerable item in some plants. There is also to be considered a reduction in the liability of "shut downs."

Of course, the manner in which a babbitt metal is applied is an essential factor in the results to be obtained. This, however, involves no difficulties whatever, as the directions for using babbitt metals are exceedingly simple and are based upon common-sense reasons. There are really only two important rules to observe in pouring a babbitt metal: First, to have all the preparations ready and pour metal as soon as it is hot enough to char a white pine stick. Originally, when this rule was made it was thought that the metal was injured by overheating, and it is true that superheating any metal does impair its vitality, but, as a matter of fact, it was only within recent years that it was discovered that if a white metal alloy was left in a highly fluid state for too long a time the various ingredients of which it was composed would separate; the lead being the heaviest would gradually settle on the bottom and the tin and antimony would work to the top, and a bearing poured in that condition would have soft spots (lead) and hard spots (antimony). As a babbitt metal is a mechanical mixture, it is very important that it should be poured in a homogenous condition.

The next rule is to heat the box and mandrel. If a metal is poured into a cold box and around a cold mandrel it will check its free flow and produce a poor casting. A cold mandrel produces a thin chill on the face of a bearing, and as this chill does not adhere very tenaciously to its comparatively soft backing it will be torn loose by the grinding force of shaft and slough out of the box. Heating the mandrel also burns off any grease or moisture that may be deposited upon the mandrel by finger prints or from other sources, and if allowed to remain upon the mandrel they will expand into gas when covered by the hot metal, and this gas will hold back the metal and cause a blowhole in face of bearing. However, the cheaper or ordinary grades of metals are liable to contain ingredients that produce blowholes no matter what precautions are taken to prevent.

These two simple rules cover practically all the law and gospel of babbitt pouring. There are several other points of minor importance to be observed. If possible, a metal should be peened before it cools off, as a hot metal yields more readily to the blows of a hammer and there is no danger of ever cracking it. Any oxide or scum should be held back and not allowed to enter the box. When a metal begins to change from a silvery to a yellowish tinge indicates the best time to check the heat.

The lack of a proper knowledge of these simple rules has frequently resulted in a good metal being condemned, or failure to secure maximum results. The importance of reducing frictional resistance as a means of gaining an increase of power is obvious. It will often save the necessity of overloading the boiler, besides the other advantages and economies pointed out. This subject is well worth the careful consideration of every user of babbitt metal.

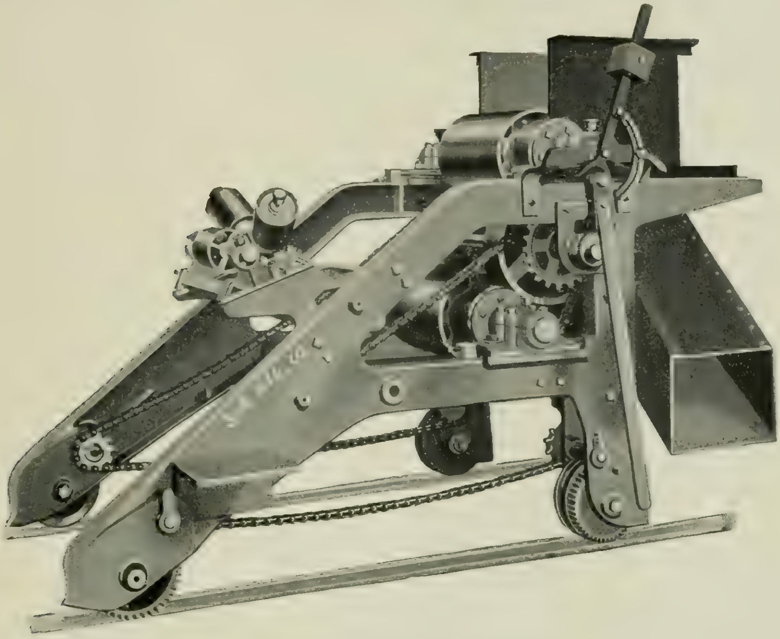
Automatic Reversing Tripper.

THE accompanying illustration shows a new automatic reversing tripper recently put on the market by the Stephens-Adamson Mfg. Co. of Aurora, Ill. There has been a great need in certain classes of work for a tripper of this sort, and it is already in use by a number of the larger mining companies

The object of a tripper, as is generally understood, is to enable a belt conveyor to discharge its load at any point along the conveyor line. This is necessary when it is desired to discharge from one conveyor into any one of several bins or to distribute the material along one large pile under the conveyor.

Their older self-moving tripper is operated by means of an iron friction wheel working on a shaft between the two tripper pulleys. This friction may engage a paper friction on either pulley shaft, depending upon the desired direction of travel. The shaft is mounted in an eccentric bushing which is operated by a hand lever to make the friction engage its mate on the desired pulley shaft. From this shaft, motion is transmitted to the tripper through all four wheels by means of gears and sprockets.

In the new tripper, the hand lever is replaced by a longer lever, hung vertically from the friction shaft in order to engage with the floor trips. In running against either trip, the lever operates the friction shaft through the eccentric bushing and reverses the tripper's direction of travel. The lever motion is assisted by, and the frictions are held in contact, by means of the adjustable weight shown in the upper part of the picture. This weight may be locked in neutral position whenever it is desired to hold the tripper at one point.



AUTOMATIC REVERSING TRIPPER.

The advantages of an automatic reverse on a tripper are that the tripper may be left unattended to work back and forth between the trips wherever located. In this way the material is piled evenly with no chance of becoming clogged until the whole pile is on the level of the conveyor structure.

The special feature of this tripper is its simplicity of design and its consequent reliability of operation. It is a decided improvement over the old methods requiring cable pulls or complicated and expensive systems of gears. Furthermore, the drive, being through friction gears, is not positive, but will allow for obstructions on the track or accidents in which a positive drive would be a disadvantage.

Industrial Notes.

—Large contracts for Detroit "Fenestra" solid steel windows have recently been made for the new buildings of the Solvay Process Company of Detroit, the Michigan Alkali Company of Wyandotte, and also to fill the openings in additional buildings of the Steel Corporation at Gary, Ind. Recent developments in modern industrial construction are particularly apparent in some of the newer railroad shops finished and in process throughout the country. The new shops of the New York Central at West Albany, and the large new shops of the Chicago & Northwestern at Chicago, show an immense expanse of windows of the "Fenestra" type, made in solid metal bars of rolled steel. In practice this more substantial filling of window openings is shown to be successful and economical.

—The R. D. Nuttall Company has introduced an innovation into railway equipment parts by bringing out case hardened gears and pinions. The Nuttall Company has had a good many of these in service for some time, but deferred announcing the new line until experience had shown that the case hardened gears would perform well under severe conditions. The operation of the gears experimented with has been so satisfactory that the Nuttall Company has decided to make case hardened gears and pinions a part of its regular lines.

—The second annual convention of the managers and department heads of H. M. Byllesby & Co. and affiliated companies will be held at the Congress Hotel, Chicago, January 17 to 20 inclusive. Byllesby & Co., which has headquarters at Chicago, operates and manages a considerable number of electric, gas and street railway properties in the West and South. Since the first convention held last year, several properties have been added to the list and the former attendance of 200 will be largely increased. At a recent meeting of a committee of managers preliminary arrangements were made for a four days' program to be devoted to technical and professional subjects. It is the belief of President Byllesby that the annual meeting and interchange of ideas among managers and department heads accomplishes much towards improving the service offered the public in the various cities where utilities are operated by this organization.

—The Lathbury-D'Olier Company, Engineers, Morris Building, Philadelphia, Pa., announce a merger of the interests of B. B. Lathbury, consulting engineer, (formerly president of Lathbury & Spackman, Inc.,) and of the D'Olier Engineering Company. The company will continue the general and special engineering, manufacturing and contracting business heretofore carried on by the respective interests. B. B. Lathbury, M. Am. Soc. C. E., formerly located in the Land Title Building, Philadelphia, has specialized in the design and construction of Portland cement plants which included well known plants throughout the United States and foreign countries. The D'Olier Engineering Company, formerly 119-21 South Eleventh street, Philadelphia, mechanical and electrical engineers and manufacturers, have done extensive work in steam, electrical and hydraulic plants, and industrial equipments in this country and abroad. The new company has established executive offices in Philadelphia and an office in New York, and with enlarged shop facilities in Philadelphia are prepared to carry on more extensive work than formerly.

—Recently a contract was let by the Chicago and Rock Island Railroad for a new freight station in Kansas City to take care of the ever-increasing freight traffic, which had to be handled. H. T. Hawk, architect for the Rock Island lines, drafted the plans for the new station. Following other experiences in reinforced concrete building construction, he specified Ferro-Lithic plates, manufactured by the Berger Manufacturing Company, of Canton, Ohio. This Ferro-Lithic plate consists of dove-tailed cross-ribbed steel sheets which act both as form and reinforcement. The concrete is applied on the upper side, while a good plastering surface remains on the lower side. A great saving in time is secured by this construction, since no wooden forms are needed. It also saves the waste lumber inseparable from wooden forms. This construction is to be used for the ceiling of the second floor of the new station, which will be used by the office force. The building is now under course of construction, the contractors being George B. Swift & Co. of Chicago. As the result of this step in concrete construction it is expected that hereafter all similar buildings erected by the railroad along its route will include specifications for Ferro-Lithic. The Kansas City freight station is planned as a model in up-to-date railroad building construction.

NEW CATALOGUES AND TRADE PUBLICATIONS.

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Air Compressors.

Platt Iron Works Co., Dayton, Ohio.—Bulletin No. 549, showing the Smith-Vaile air compressors, both steam and power actuated.

Buckets.

Hayward Co., 50 Church Street, New York City.—An elaborate portfolio showing dozens of illustrations of Hayward buckets and digging machinery in actual work. The devices shown include orange-peel buckets, clam-shell buckets, excavators, dredges, coal-handling machinery, traveling derricks, derrick fixtures, etc.

Centrifugal Pumps.

American Well Works, Aurora, Ill.—This is an elaborate catalogue in colors illustrating a very full line of centrifugal pumps, both volute and turbine. This catalogue contains a vast amount of information and data of positive use to any one concerned in the moving of water.

Die Castings.

H. H. Franklin Mfg. Co., Syracuse, N. Y.—Descriptive pamphlet illustrating Franklin die castings. In this process molten metal is forced into steel molds under high pressure. The metal is then quickly cooled and the finished casting removed. The result is a casting the counterpart of machine-finished work.

Feed-Water Heater.

National Pipe Bending Co., New Haven, Conn.—A small catalogue illustrating the National feed-water heater, of which more than 3,000,000 H. P. are in daily use. The special features of the heater are that there are no inside joints to leak; no straight tubes to leak; no back pressure is possible, and there is no contact of water with the shell or iron.

Graphite Products.

JOSEPH DIXON CRUCIBLE CO., Jersey City, N. J.—A pamphlet entitled "Graphite Products for the Railroad," the object being to bring before the mechanical departments of railroads the advantages of graphite products in the proper maintenance of railway equipment.

Locomotives.

BALDWIN LOCOMOTIVE WORKS, Philadelphia, Pa.—Record No. 67, being a pamphlet illustrating locomotives recently built for passenger service.

Motors.

TRIUMPH ELECTRIC CO., Cincinnati, Ohio.—Bulletin No. 391, showing Type F direct current steel frame motors designed to supply the demand for a strong, lightweight machine of high efficiency and good-wearing quality.

Pipe Covering.

A. WYCKOFF & SON CO., Elmira, N. Y.—Illustrating Wyckoff's steam pipe covering for underground and exposed steam pipes and hot-water pipes. The Wyckoff covering is constructed of eight seasoned white-pine staves, selected, free of all sap, to insure greater durability. The staves are closely jointed, wound with heavy galvanized steel wire, and then wrapped with two layers of heavy corrugated paper.

Pumps.

BUFFALO STEAM PUMP CO., Buffalo, N. Y.—Catalogue No. 209, showing single, duplex, and triplex power pumps, centrifugal pumping machinery, vacuum pumps and condensers of every description for all requirements.

Recording Gauges.

BRISTOL CO., Waterbury, Conn.—Bulletin No. 140, illustrating in detail Bristol's recording gauges for all ranges of pressure and vacuum.

Separators.

AUSTIN SEPARATOR CO., Detroit, Mich.—Catalogue No. 16, for the year 1911, illustrating the Austin steam and oil separators of standard, receiver, and accumulator types for the elimination of water from live steam, extracting oil and impurities from exhaust steam, and the separation of oil, grit and moisture from compressed air, gas, etc.

DIRECT SEPARATOR CO., Syracuse, N. Y.—An illustrated pamphlet describing Sweet's combination oil and water separators for low-pressure turbines, a field which has called for a combination separator suitable for removing both the oil and the water from the exhaust steam after it leaves the reciprocating engine and before it enters the turbine.

Steam-Power Stations.

STONE & WEBSTER ENGINEERING CORPORATION, Boston, Mass.—A handsome booklet containing photographs of a number of steam-power stations, designed and built by this engineering corporation. The arrangement is particularly attractive.

Steam Trap.

Leaflet illustrating and describing the Kitts T. C. steam trap. Kitts Mfg. Co., Oswego, N. Y.

Switchboard Panels.

GENERAL ELECTRIC CO., Schenectady, N. Y.—Bulletin No. 4749, illustrating alternating-current switchboard panels of the sectionalized type. Each section has a separate catalogue number. The panels are in three sections, and the pages of the bulletin itself are so sectionalized that the user may have before him a picture of the complete panel desired, together with a full description of the equipment.

Turbines.

In addition to building Rateau-Smoot turbines of the high and low pressure types, the Ball & Wood Co., Elizabethport, N. J., announces by means of a new catalogue just issued that it is also building these turbines, which are of the impulse type, for mixed flow pressure. The new type consists of a straight low pressure turbine with supplementary wheels to economically use high pressure steam by means of an automatically controlled governor.

Woodworking Machinery.

J. A. FAY & EGAN CO., 212-232 W. Front Street, Cincinnati, Ohio.—Catalogue No. 84, of 384 pages, in two colors, profusely illustrated with half-tone plates and bound in a five-color cover. This catalogue is a reduced reproduction of the company's large general catalogue.

THE
ENGINEERING MAGAZINE
"THE WORLD IS ITS FIELD"

VOL. XL. FEBRUARY, 1911. No. 5.

ENGINEERING IN THE NAVY. ITS ORGANIZATION AND EFFICIENCY.

By Ira N. Hollis.

Present conditions in the United States Navy are of acute interest. The situation focalizes movements that are stirring in all the great navies of the world—the cumulative effect of the influence of engineering upon personnel, material, and organization, as steam and power have progressively displaced sail and hand service.

Professor Hollis weighs the questions at issue with the sympathetic and intimate knowledge acquired by long naval service, but with the breadth of vision and perspective acquired by long removal from that service and constant contact with the methods and ideals of general engineering practice. His conclusions, reached without impetus of any special interest, without bias of any departmental relation, without even mental suasion of any particular industrial philosophy, should be of much weight, as they add authority to their sincere purpose to arrive at truth. They are presented in the same spirit in which they were prepared.—The Editors.

A MODERN battleship is the most complicated structure designed and built by engineers. It is essentially a power-station of large dimensions which is capable of moving, and within which the operating force must live. Furthermore, they must be able to make their own repairs so far as possible within the limits of the hull, and they carry as part of the machinery, offensive power capable of reaching out seven miles. To one not trained in engineering a battleship is a profound mystery. Its power is incomparably greater than that in any industrial establishment even on shore a generation ago. A single one of the American battle-fleet lately returned from Europe, in the hands of the Confederacy, would have destroyed the entire Northern navy. Not a ship, nor any combination of the then existing ships, could have remained on the blockade. The cost of a modern ship must therefore be contrasted with that of an entire navy in the past of only forty years ago, in order to get anything like a fair idea of what should be paid for new ships.

The change from the old types has been entirely one of engineering, necessitating a complete reorganization of the personnel to fit modern requirements. The new United States navy was begun by Secretary Whitney in the purchase abroad of the plans for three cruisers and one battleship. Previous to his administration, all cruising ships had been constructed with sail power. The navy had been so long under an old system that we had no architects or engineers conversant with modern construction for high-speed ships. Mr. Whitney's action was, therefore, both patriotic and courageous, and by it we were put in the way of replacing our decaying ships and of ridding ourselves of the old fetich of "keeping the sea under sails."

It was during his time that a large contract for armor-plate was signed with the Bethlehem Company, thus justifying a large initial expenditure in the establishment of an armor-plate manufactory. The gun foundry at Washington was also authorized by Congress at the same time. The progress since Mr. Whitney's administration has been rapid, as ship after ship has been replaced and the navy has regained the effectiveness it had at the close of the Civil War, except that this recovery is under totally different conditions.

With the building of an engineers' navy the education and training of men for service afloat had to be modified, but the change came hard as all the senior officers in control during the years preceding the Spanish War had learned their professions under an antiquated system. The Personnel Bill was passed by Congress early in 1899. It had many good features, the principal ones however being an amalgamation of the line and engineer corps into one corps, the establishment of a grade of warrant machinists, and the correction of inequalities as to pay. Many were the dire results predicted as the consequence of the disappearance of the technical corps whose duties had been exclusively with machinery. The measure was framed in reality for two reasons: one was to cause every line officer to pass through an engineering apprenticeship; and the other was to break up the eternal fight between the line and staff. This fight had reappeared in every session of Congress from the close of the Civil War. It has sometimes been treated as the inevitable struggle between corps in every military system, but it was far more than that. The last forty years have been a period of readjustment, not only in the navy but in all modern industries, and precisely the same struggle has taken place in civilian establishments that we have observed in the navy.

The line in swallowing up the engineer corps brought itself into correspondence with modern conditions by converting itself into a larger engineer corps. The Personnel Bill thus ended, we may hope forever so far as the organization afloat is concerned, that useless struggle which set against one another men of high motives and conscientious desire to serve their country faithfully. In taking the engineer corps into the line, the navy reserved all the older officers who had been chief engineers, exclusively for engineering duties, and they have served to train the young line officers to succeed them. The younger members of the engineer corps were taken bodily into the line in every sense of the word. The troublesome period of readjustment has thus been tided over by a liberal infusion of trained engineers into the executive branch. The fate of the older engineers has been an unhappy one, and they have scarcely received the recognition they deserve for faithful and unselfish service. The task of training the younger officers to take their places, while being pushed into the background themselves, was a very severe test of patriotism and unselfishness.

The course at the Naval Academy quickly responded to the changed requirements for its officers and it became in every respect an engineering school equal to anything in the country. In one important respect it is better than most other schools; men are there taught to do without question what they are told to do, so that some deficiencies in the curriculum are more than made up in the stern discipline which prevails over all. The training of the enlisted men was quickly made to fit the new demands, and best of all, in the Personnel Bill, a way was found to reward good practical mechanics by promotion from the ranks to a grade of warrant machinist. The law also allows, in exceptional cases, the warrant officers to obtain by examination and record the same commissions as those held by graduates of the Naval Academy. The navy is thus a thoroughly democratic institution and any fireman has the way open to a commission in the line of the navy if he has the ability, energy, and youth necessary to obtain it.

Thus by legislation and executive action in connection with materials during Mr. Cleveland's first administration and again by legislative action affecting the personnel during Mr. McKinley's administration, a complete revolution was accomplished in the navy. Strange as it may seem, that revolution did not extend to methods of doing work in the navy yards, although a legitimate consequence of the personnel legislation. The old methods prevailed until they were modified by a sweeping executive order issued at the very close of Mr. Roosevelt's administration. This order took up the subject of concentration of work in the navy yards and followed it to its logical conclusion by abolishing completely the bureau departments of the yards and placing all work under the direction of a manager subject to orders by the commandant. The plan was in the right direction, but it went too far and aroused intense antagonism throughout the entire Service.

A great opportunity thus awaited Secretary Meyer to complete the work begun by his predecessors, and especially that inaugurated by his immediate predecessor. Fundamentally, it is simply extending the legislation as to personnel and materials afloat into workshops that serve for construction and repairs. Some new legislation is required, but it is simply a corollary to the action already taken by Congress in the passage of the Personnel Bill.

The new Secretary has, unfortunately, found the same kind of opposition that faces every man who does a great work, and the slowness of Congress to support him is an astonishing revelation. Here is a body of intelligent men elected for their grasp of national affairs, who falter when it comes to the completion of the task begun by themselves twelve years ago.

This article is intended to deal mainly with engineering, and it will therefore be more appropriate to refer to the reorganization later after having investigated in as much detail as will be permitted, how engineering has fared in the navy since 1900, while it has been in the hands of a corps whose duties include navigation, seamanship, gunnery, engineering, and the general executive direction of the ships as a whole. In other words, has the Personnel Bill of 1899 accomplished what its authors hoped?

We must remember that the chief cry against the new legislation related to specialization, and it was constantly stated that "no officer can be everything on board ship." The fact was entirely lost sight of that the bill passed by Congress never contemplated anything of the kind. It was a method of placing engineering on an adequate footing in the navy—in fact, of exalting it as a profession; and, best of all, of affording the Navy Department a means of selecting technical men from a much larger number of officers who had shown in service their special fitness. There is ample room in the one corps, having charge of executive work and the operation of machinery, for any amount of specialization as the officers show aptitude for it. Formerly, the engineer corps of the navy was selected by the appointment of cadet engineers at the Naval Academy, all of whose careers were to be in the technical corps. Later, the engineer corps was recruited from the cadet midshipmen at the Naval Academy, most of whom tried to avoid it. Now every officer has an engineer's education and every one must go through an apprenticeship in engineering.

The provisions of the Personnel bill seemed unsatisfactory at first for several excellent reasons. In the first place, it had accomplished in one stride the advance from an inadequate organization developed in the centuries under sails, to a modern system under which a battleship is treated as a great power plant for war purposes. The transition could not have been made without confusion, under any conditions, and the suddenness of the change was like upsetting the whole Service. The navy of sailors could never become a navy of engineers simply by Act of Congress. Much had been done at the Naval Academy to pave the way for a change, but nevertheless it was too quickly accomplished to work smoothly.

In the second place, there was a great scarcity of officers for a number of years after the Spanish War. All available officers were taken out of the engine room and placed on deck, to the detriment of engineering. No deck officers were put below to learn machinery and to fit themselves to take the places of the older engineers.

In the third place, it was unfortunate that the officers into whose hands the new organization fell were either lukewarm or distinctly opposed to it. They undoubtedly tried conscientiously to do their duty, but they were scarcely qualified to look things straight in the face and to carry out a plan demanding high enthusiasm. The consequence of this attitude was that in engineering matters the navy drifted for five or six years, and the criticism against the outcome of the Personnel Bill was entirely justified. It looked for a while as if the Department would be obliged to employ civilian engineers or to extend the duties of the corps of naval constructors to the design, direction, and management of machinery. That time has, however, passed by and the past four years have demonstrated the capacity of the line to cope with the whole question.

It is not to be inferred from what has been said above that the navy has not been able to carry on its duties effectively. Mistakes were made that might have been avoided under a wise administration and some serious accidents resulted; but the wonder is there were so few. The repair bill was high; but again, that naturally followed an enormous extension of power. When one contrasts a modern battleship, having one hundred or more machines and twenty-thousand or more horse power, with the fighting frigate which contained just power enough to get out of its own way, one has reason to expect a greater repair bill.

While the officers of the navy had, on the whole, favored the passage of the Personnel Bill in 1899, it is probable that the majority had comparatively little faith in that provision which united the engineers and line into one corps. The doubt was not entirely removed until the battleship voyage around the world demonstrated that ships could be taken on long voyages without breakdowns; that the same corps could navigate and propel these ships without serious hitch. This proved conclusively the possibilities of the new organization.

To return to the "age of specialization" argument, it must be remembered that this is an engineers' navy; as Mr. Roosevelt said, every officer is a "fighting engineer." It must furthermore be frankly recognized at the Naval Academy that the fundamental part of the education for all executive officers is some form of engineering, and the officers have been quick to give this recognition. Every midshipman has the same general preparation up to the time of his commission, and there is ample opening for all the specialization he wants on board ship and in the navy yards, so that the claims for specialization are fully met.

Engineering in the Service may be divided into two parts: that which is done on shore and that which is necessarily confined to a ship in commission. The latter requires an organization exactly similar to that of any large power station, with the addition that it is for war purposes. If the staff managing a power station were required to design and build its own machinery in addition to operating it, there would be an excellent parallel between the conditions on shore and those on board ship.

Another division of engineering is into four parts:

1.—The design of ships and machinery, including guns, propelling engines, and all accessories.

2.—Construction.

3.—Operation.

4.—Maintenance and repairs.

The first and second of these are carried out entirely on shore. The third is purely a sea-going business, and the fourth may be either.

The repairs to the hull and fixed parts of a ship must commonly be done at a naval station. The repairs to machinery, so far as possible, should be done on board ship by the crew, to the end that a fleet of ships may be self-sustaining in foreign waters. The general overhauling and extensive repairs in fitting for sea are necessarily a navy-yard operation.

The orders issued by Secretary Newberry during his very brief term of office, reorganized the navy yards by placing all work under the immediate management of a naval constructor. This was a distinct improvement. The old system of having as many heads as there were Bureaus at the Navy Department, with very imperfect co-operation, was wasteful and slow. Furthermore, it was used as a means of giving officers shore duty, not selecting them for their special ability but because it was their turn to have relief from sea service.

The managers for the yards were taken from the corps of naval constructors for several very good reasons. Of course all their work was subject to the approval of the commandant who is a line officer. By Mr. Newberry's order the former heads of departments became simply inspectors of work done under the direction of the works manager. This system seems at first glance an excellent one, but as a corollary it gave the general direction of all repairs and construction, as well as design, to the Bureau of Construction. No doubt the argument which appealed to Mr. Newberry was a perfectly valid one. Here was a corps of officers selected from honor graduates of the Naval Academy, specially educated in post-graduate schools at home and abroad, and always available for shore duty. They had demonstrated in the upbuilding of the modern navy a high order of ability, and, on the whole, they had been successful.

But, with all the arguments in favor of the new system, [promulgated over night,] granted, the organization was too hasty and its effect was to throw out of work, and effective control of work, a large number of men fully as able to direct navy-yard operations as the corps of constructors. This naturally aroused intense opposition, and bade fair to rouse internal strife quite equal to that which continued for the thirty years preceding the passage of the Personnel Bill.

The work of the Service has a perfectly natural grouping under two heads: one, the hull and fixed parts of the ships repaired only in a navy yard or dry dock; and the other, the guns and machinery subject to constant wear and tear and repaired either on board ship or on shore. Mr. Newberry's order utterly failed to take into account the immense educative value of placing engineering officers directly in control of repairs to machinery on shore. A naval station is more than a manufacturing establishment; it is established for the purpose of enabling our ships to keep the sea, and the training of officers to do their work effectively at sea may be regarded as much a part of the yard functions as actual repairs and construction; otherwise, repairs might better be done by private ship-yards where much more construction is carried on than would ever be possible in a navy yard.

Another objection to the new order was that it established a divided responsibility. It was claimed in argument against this that the sea-going officers were made inspectors of the work done under the direction of a naval constructor and that they thus became responsible; but, it was at best the establishment of another link certain in a short time to prove weak.

Mr. Newberry's plan would undoubtedly have been better adapted to the conditions if his managers had been selected for special fitness without regard to corps, and if all construction and repairs in the yards had been placed directly under an assistant secretary of proved executive capacity, instead of under one of the Bureaus. It would still have had the disadvantage of taking from sea-going officers the responsibility for their machinery. By placing all practical management under one corps of officers already in control of a very large part of the naval appropriation, a strong political machine was established which ultimately would have dominated every department of the navy, to the great detriment of effective control by the Secretary himself. This was perhaps the worst aspect of the plan, as any Secretary would have been helpless in the hands of a single corps having a great sum of money to distribute among the navy yards, especially as the members of that corps could not generally be ordered to sea duty. This has absolutely nothing to do with the personality of the corps which Mr. Newberry selected to take the management. Our corps of constructors is a first-rate body of officers, splendidly equipped to do important service for the Government, and their desire to obtain control of all the shops in the yards undoubtedly proceeded from a very sincere conviction of the efficiency to result; but they are human and they ought to feel the change wrought by Mr. Meyer as a measure in their own interest. Certainly it has saved them from the temptation incident to great increase of power.

Secretary Meyer went into office with an excellent reputation for efficiency in the Post-Office Department, but without previous experience in the navy. If any doubt existed as to his stamina in dealing with a difficult administration during a period of confusion and strife, that doubt has been amply removed. His fairness, good sense, and firmness on every question placed before him should give him the hearty support of every officer and the backing of Congress. It is astonishing that there should be any opposition to his plans. One of his earliest official acts was a frank acknowledgment of ignorance on technical matters by the appointment of a board to study and report on the organization of the navy yards. While holding to the concentration of work under a few heads, as established by his predecessor, he was placing himself in a position to carry that idea into effective operation without disrupting the entire service. The finding of the board was a perfectly simple one, viz., to create two departments in every yard for construction and repairs—one for the hull and the other for the machinery—both under the responsible control of a well selected commandant. This was carried out by the Secretary. He simply left the hull work under the constructors and he placed the repairs to machinery where they belonged, in the management of sea-going officers.

The next step was not strictly engineering as it related to a better system of keeping accounts. It is not necessary to refer further to it here as an entire paper would be required to state it fully.*

The third step related to the bureau system at the Navy Department, recommendation being made to Congress that the Bureau of Equipment be abolished and that its work be divided amongst other bureaus. A bitter fight followed this recommendation, as the Secretary, after investigation, had decided to place a large part of the electric machinery under the Bureau of Steam Engineering, whereas the Bureau of Construction wanted it. There is something almost grotesque about this squabble amongst serious-minded officers, as either bureau was amply competent to install it. Neither, in the nature of things, could have much to do with its manufacture, and the Secretary showed his good judgment by giving its selection and installation to the officers who were going to operate it.

The fourth step taken by the Secretary was the appointment of four aides to advise him on all matters pertaining to the service. The only one of these concerned directly with engineering was the aide on materials, and Mr. Meyer's obvious intention was to obtain advice from an experienced officer on the conflicting claims of bureau chiefs. The system of settling these claims was, at best, a makeshift, as it simply referred them for adjustment to a board consisting of the officers who made the claims. This arrangement in a military service is bad in theory and practice, and the proposition to have a single officer of proved ability pass on recommendations where there is conflict between different bureaus, is an excellent one.

The Secretary's trouble began with Congress. Those measures which he could carry into effect by the President's authority were quickly ordered, but it was only after a hearing and much discussion that Congress gave a grudging consent to a trial of his plans for one year, and although he can order the aides and give them definite duties in the Department, some legislation is required to make their positions effective. Congress does not seem inclined to grant this. The whole subject is once more up for consideration and the arguments will have to be made again. The Secretary's report shows at least that his plan has worked well for six months and that there has been a large resulting economy in naval expenditure. While it may be doubted if the time has been sufficient to establish the latter point effectively, there is no question of increased efficiency throughout the service.

---

*It is hoped to present, in an early issue of The Engineering Magazine, an authoritative review of the accounting system and its results.

A complete new organization of the Navy has by Mr. Meyer's order followed the passage of the Personnel Bill of 1899, only ten years behind it, and while it will greatly improve the conduct of work in the navy yards, there is a more important question of the actual experience on board ship during these years. The management of machinery, or that branch of engineering which comes without question under the sea-going officers, is of overwhelming importance. Repairs may be done on board ship, but they can also be done at private ship-yards as well as in the navy yards. Hence the organization for handling and fighting the ships transcends everything else. We have had eleven years of experience with machinery since the passage of the Personnel Act. On the whole it has worked well and officers generally are satisfied. The first need seriously felt as the older engineers dropped out, was for designers of machinery and for highly trained technical men to direct the construction of machinery, all of them selected from the line of the navy. This need has been supplied by another of Secretary Meyer's orders in the establishment of a post-graduate course in engineering at the Naval Academy. Ten officers are selected every year and the course covers two years in all branches of engineering commonly practiced at sea. There are thus twenty officers under instruction at the Naval Academy. The first class of ten was selected in the fall of 1909 from about two hundred applicants for the instruction. From these classes two will be taken every year for designing machinery and superintending its construction. The course of studies is highly practical, including the summers spent in the inspection and study of industrial processes at various large commercial establishments. While the space of this article does not permit a statement of details, it may be said that the course covers a consistent study of engineering and time is found for lectures by a number of experienced civilian engineers, manufacturers, and teachers.

The Naval Academy is thus brought into closer contact with other branches of engineering than that pertaining strictly to the navy, and it is broadened out somewhat. More can be done in this way for the midshipmen as well as for the commissioned officers. This post-graduate course is new, but in connection with the experimental station at Annapolis and with the navy yards, there is no reason why it should not develop a body of trained engineers for all contingencies.

Attention has been called to the argument against placing the management of machinery on board ship in the hands of the line—that corps which is also responsible for deck duties and the general management of the ship—as acting contrary to the tendency of modern industries. Specialization is certainly the tendency of the day. It is required in the trades and, what is more, it is thoroughly practiced in the enlisted force of the navy. So far as the officers are concerned, it is highly important that every one of them should qualify in practical engineering after graduation. Everything on board ship requires the control and operation of engines. There is absolutely no reason whatever why the qualifications that enable a man to direct and care for the machinery of a gun, or of a dynamo-room, should be any different from those required in managing the propelling engines—both require the same kind of specialization and the same man can do both. This does not change the fact that some men will operate guns better than others and that some will do best in the engine-room; the choice can be made by them. But, inasmuch as their fundamental training has been the same, they can, without any jar on the present scheme for specialization, belong to the corps which commands the ships. A slight examination of the records during the past few years will demonstrate the complete success of the present organization. In the matter of coal consumed on board ship, it may be assumed that lack of efficiency would appear in a much larger coal bill, yet the past few years have shown a steadily decreasing expense.

A brief table of three classes of ships affords a very fair comparison in this respect. They are all figured on the coal per indicated horse-power, thus eliminating the size of the ships and their speeds from consideration. There are three classes set down in the table on page 684. The first represents the average for ships commissioned during the past five years; the second for those commissioned in the 90's; the third for those of the 80's.

It is only fair to state that the machinery for all these ships was either designed or inspected by officers of the old engineer corps, but the ships of the first group have been operated entirely under new conditions by line officers who certainly show no falling off in the economical expenditure of coal. One of the most effective systems for promoting efficiency in this regard is the offering of prizes for economy of coal and efficiency in the engine-room department. This began on the battleship cruise around the world. It encourages the same zeal in the fire-room as is produced on deck by prizes for the best target practice.

It is difficult to make reliable comparisons on the cost of repairs to machinery and boilers. Testimony before a Congressional investigating committee on the merchant marine shows that the annual cost of repairs to machinery on merchantmen exceeds 9 per cent of the value. Expenditure for similar purposes in the navy is only 2 per cent of the value. This great difference is probably due to the fact that the enlisted force can do a large part of the repairing on board ship, in which case no charge for wages is made. The warrant machinists are leading men for the repairs which are always under the supervision of an officer.

SHIPS OF 1905-1910.	Coal per i. h. p.	Speed.
North Dakota	1.739	21.66
Flusser	1.923	30.41
Michigan	1.690	17.95
South Carolina	1.395	18.86
Birmingham	1.932	24.32
	1.736	
SHIPS OF 1890-1900.		
Indiana	2.023	12.08
San Francisco	2.03	19.52
Oregon	2.150	16.791
Olympia	2.190	21.68
Baltimore	1.707	20.09
	2.015	
SHIPS OF 1880-1890.		
Chicago	2.63	15.13
Concord	2.76	15.8
Dolphin	2.19	15.5
Boston	3.11	13.8
	2.67	

Another statement which illuminates this side of the question is that the total engineering expenses in 1907 for each horse-power in the navy, were 6.04; in 1908, 4.39; in 1909, 4.31; in 1910, 3.97. The coal for steaming purposes per knot including tugs, colliers, and torpedo craft was: 1907, 1,027 pounds; 1908, 801 pounds; 1909, 755 pounds; 1910, 740 pounds.

The casualty list and break-downs cannot easily be compared with the same things in the old navy, or under the old system of a separate engineer corps. The ships are so utterly different and so vastly greater in power that there is no basis of comparison. The chief casualties have been in connection with the guns where the line officers are supposed to be experts. The explosion on the Bennington has often been quoted as a result of turning machinery over to amateurs, and doubtless there was some lack of efficiency on that ship. The organization was probably bad and the officers did not look after their work as they should have—but that might occur under any system and has occurred before. Without any data beyond a list of the casualties that have occurred in recent years, one would be fully justified in saying that casualties have lessened. Especially is this true if taken in proportion to the amount of machinery placed in the hands of the officers.

One of the features of the new administration is a confidential bulletin issued by the Bureau of Steam Engineering to give officers in ships scattered over the world definite information on all kinds of subjects pertaining to engineering. The following is taken from one of these bulletins to show in a general way the organization for carrying on work and for operating the machinery. It is that worked out for the battleship *Michigan*:

> The senior engineer officer is responsible for the management, maintenance, and care of the machinery. He supervises everything under these heads. Every part of his duties is delegated to some one else to attend to so that he may be free to see that the others do their work, and do it properly.
>
> This, of course, does not mean that the senior engineer officer fails to make any of the inspections, reports, etc., called for by the Regulations.
>
> The assistant to the senior engineer is a lieutenant regularly assigned to engineering duty. This officer aids the senior engineer as directed, takes charge of all work going on in the engineer department, in port, and does such watch-standing duty as may be assigned him.
>
> The chief machinists and machinists do not keep watch nor day's duty, but devote themselves to the care and maintenance of their stations and endeavor to keep them at the highest state of efficiency.
>
> Midshipmen are assigned to the engineer division for instruction. They perform watch-standing duties as required, write reports of work performed in the engineer department, write descriptions of machinery as directed, and carry out the prescribed course of instruction.
>
> Watch-standing officers stand regular watch under way and perform day's duty in port. These watch-standing officers do not form part of the engineer division except for watch standing. They are commissioned officers. During the forenoon of such days as drills take place requiring the presence of the officers on watch, the assistant to the senior engineer takes the entire forenoon watch. This is, generally, every day except Saturday and Sunday. The assistant frequently takes a night watch at sea.
>
> A daily employment list is made out each day and is placed in the office at the close of the working day. It shows the employment of every man in the engineer division. In case the man is employed on repair or overhauling work, the number of the work item is placed opposite his name. In other cases, his condition is noted by symbols indicating that he was sick (M); on station (S); cleaning bilges (B); on watch (W); absent with (L) or without leave (A); confined (C); at drill (D); in a working party (P); performing extra duty (X), etc.
>
> A case is filled with cards arranged alphabetically, with a separate card for each piece of machinery in the ship. In another case are kept records of each item of work done, arranged in numerical order.

Work is originated by the senior engineer officer, by his assistant, or by the machinist in charge of a station. If an item of work originates with the senior engineer, a memorandum of the work to be done is made out in the job-order book and sent to the assistant. The assistant has it entered on the daily-employment list of the machinist concerned. The same method is pursued if the work originates with the assistant. If a machinist in charge of a repair station originates the work he makes a request for permission to do the work and for assignment of an item number, using a printed form supplied for the purpose. The request is passed upon by the senior engineer and by his assistant, and, after it has been approved, the yeoman prepares a record-item card and puts it in the box for work in progress and not completed. This same method is followed for all repair work and for periodical overhauling.

When an item of work is completed a rough description is filed in the office by a midshipman, after consulting with the machinist under whose charge the work was done. This description embodies:

(1) The reason for the work.
(2) The condition in which the part was found.
(3) A full account of what was done.
(4) Tests made and witnesses.
(5) The names and hours of employment of all men employed.
(6) The dates of beginning and finishing.
(7) A list of all stores used.

These reports are examined and corrected by the assistant and then are typewritten on the record-item card. This card is then filed in its regular numerical order, but the work is indexed on the cards in the alphabetical machinery list. There are about 1,000 cards in this machinery list on the *Michigan*. By examining any one of these cards reference is given immediately to every item of work done on that particular piece of machinery since the delivery of the vessel from the builders.

Navy yard work is carded and indexed in a similar manner, but with record cards of a different color.

For keeping track of routine tests and inspections, printed forms have been prepared on the *Michigan*, showing those tests that must be made weekly, monthly, quarterly, semi-annually, and annually. These forms are filled out by the machinists, who keep copies for their own use. For the large items, separate numbers are assigned.

For stores, a card system is used with cards of different colors for Title "Y," for Title "B," and for "spare parts." The class number is written in on a tab on the top so that it is easy to check up the class cards. A separate set of cards is used for the class ledger. The original vouchers are used instead of an expenditure book or bill book, in order to save work. The store cards are arranged alphabetically, and little metal guides are put on those that have articles to be placed on requisition.

The forms used in this system are as follows:

(1) Memorandum for senior engineer officer, from machinist in charge of repair station, reporting work that should be done on his station and requesting the assignment of item numbers.

(2) Record card of work done. This card includes features already described and a reference to any correspondence there may be upon the subject.

(3) The same as (2) except of a different color. This card is for work done at a navy yard.

(4) Store cards, of different colors for different titles, with tabs to show classes. These cards show name of article, where it is stowed, the ship's allowance, and also voucher number and date, quantity, unit, and total cost, and place from which received.

(5) Class store cards. Those show voucher number, date, and amount for receipt and for expenditures. Only as many of these cards are required as there are classes.

(6) Bunker inspection form. This shows the bunker numbers and capacities and leaves blanks for amount on hand and date.

(7) Employment report. This shows actual employment of every man on a station for every day during a week.

(8) Periodical tests and inspections. These are prepared separately for each repair station and, as before described, for each period—as weekly, monthly, etc.

(9) Memorandum reports for log showing work in progress and tests or inspections made for each station. These reports are made by the machinists to the officer of the watch.

(10) Station billets.

(11) Ice-machine log.

(12) Evaporator log.

(13) Auxiliary watch list.

(14) Water log, showing amount of water on hand at midnight in each boiler and tank. If stores are obtained, the item of the work must be given the storekeeper.

When requests for repairs are submitted, they are accompanied by a complete copy of all record item cards referring to the machinery for which repairs are requested. In this way considerable assistance is given to reviewing officers, and it is easy to show that a request is not unreasonable.

When some such organization as that above outlined is fully established on all our ships, the engineer force will be up to date; but time is required and criticism should take into account that officers in the navy are dealing with the same problem that all industries have had to face. Consolidation for greater economy and efficiency is the watchword throughout the whole country, and the navy question is only one phase of it. The Secretary of the Navy has taken it up seriously in all departments, and the members of Congress should not permit any internal feuds among naval bureaus to delay definite and wise action. A great piece of work for the personnel of the navy was accomplished by the House Naval Committee in 1899. Now let Congress bring the seed then planted to full fruition in equally important legislation for the navy yards and for the Department as a whole. Of one thing the people of the United States may be certain: their ships are not going to be allowed to fall off in power and efficiency so long as the officers (whatever corps they serve) are permitted to do their work without political interference.

MONOPOLY AND PROGRESS.

By Dr. Franz Erich Junge-Hermsdorf.

II. CONCENTRATION AND EMANCIPATION OF CAPITAL.

In a series of three articles, of which this is the second, Dr. Junge brings unusual faculties of observation and analysis to bear upon existing industrial conditions in the United States. He views affairs with the double advantage of an intimate acquaintance with the engineering industries and an external perspective of American economic policies and tendencies. His criticism will be made constructive by a presentation of available measures for betterment as proved by the experience of other lands.—The Editors.

WITH due respect to the older definitions of the term, and in view of the changes attending the evolution of industrial society in the mean time, we define capital as the means affording their possessor a competency in the lean years and a special opportunity for profitable production in the fat years. While, in most cases, it is our inborn ability, physical or mental, which enables us without expensive education to secure a position as wage earner somewhere in an agricultural, commercial, or industrial establishment, we know quite well that it is only by the investment of capital, of accumulated or inherited fortune, that we can become stockholders or partners in those establishments, thus reaping a surplus benefit from the toil of others.

The presence of capital in a commonwealth, however democratic may be its constitution, is bound, sooner or later, to create privileged classes, enabling them to conduct enterprise on a large scale, and, by attracting a larger and larger part of the sources of production, to gain control over men and affairs. Nor can this function of capital be regarded as harmful to the commonwealth, as long as the money is kept circulating through the exchanges of the country, serving as a fertilizer and stimulator of national progress. But certain it is that the evolution of industry has strengthened the plutocratic form of government quite as much as slavery once aided in the upholding of feudalism. It is chiefly by replacing human labor by mechanical means, by cutting out to a large extent the personal element in production, and dealing with quantities and values never dreamt of before, that capital has succeeded in subordinating everything to its dictum. So today, individuals are beginning to dread the power of capital for the same love of liberty that once made them dread the power of government.

Speaking of "the *power* of capital," it is necessary to get a clear understanding of its meaning and to give a few data showing to what extent wealth is concentrating and gaining control over the United States. The returns of the new Census not being available, we have to base our conclusions upon the results of private inquiry. John Moody and Sereno S. Pratt, both high authorities on financial matters in the States, maintain that, while there are a number of other large groups in special lines, there are actually only two influences that dominate immense areas in all lines, transportation, public service, industrial, financial, banking, insurance and so forth. These interests are centered in the Morgan and in the Rockefeller group, respectively. While the Morgan interests represent a capital of nearly ten billion dollars, which is equivalent to nearly 10 per cent of the entire estimated wealth of the United States at the present time, the Rockefeller interests represent an even larger aggregate of capital. It will be a matter of few years only when one will be more or less completely absorbed by the other, and a grand close alliance will be the outcome of conditions, which, so far as human foresight can see, can logically have no other result. Outside of this central group are half a dozen smaller ones which probably represent a further corporate control of fifteen billions of capitalized values. But these smaller groups are identified either with the Morgan or Rockefeller part of the group, so that we may fairly state that the capitalized valuation of probably thirty-five billion dollars is concentrated in the hands and under the control of not less than a dozen men.

Says John Moody:

> A careful estimate of the corporate capitalization now existing in the United States indicates that, outside of small close business corporations owned by individuals, the total corporate capitalization in par value in the United States at present is not over $43,000,000,000. The wealth of the United States, according to last reports, was in the neighborhood of $110,000,000,000, of which about 50 per cent was represented by realty values, the balance being tangible property of thousands of different kinds. So that we see, after all, that the trend towards concentration in corporate control has now extended so far that approximately 80 per cent of all the vital corporate capital of the country is under the domination or control of this powerful group of Wall Street interests which we have referred to.

Of course, there is the old theory that, corporations being composed of a number of individual shareholders and representing an approach towards the socialism of private enterprise, the corporate wealth of the country is distributed over a fairly large percentage of the population. Yet, taking seventy of the leading corporations of the Union, it is found that in railroads not more than

288,000, and in industrial companies no more than 338,800 shareholders are interested. Of these shareholders, it must be remembered, only a small percentage is represented by individuals. Thus, for instance, of the $17,500,000,000 of railroad stock now outstanding in the United States nearly 30 per cent is held abroad, nearly 20 per cent is owned by the railroads themselves: to banks other than savings banks is credited about 6 per cent, to insurance companies about 4½ per cent, and to savings banks nearly 4 per cent. Altogether, 65 per cent of the total is thus to be accounted for as not owned by individual investors living in America. And, taking the wealth statistics of the Tenth Census, it is found that 0.3 per cent of the American people owned 20 per cent of the wealth, 8.97 per cent of the people, 51 per cent of the wealth, and 91 per cent of the people only 29 per cent of the wealth. For comparison I give the corresponding figures from Germany, compiled from the official statistics by Professor Gustav Schmoller, of Berlin. It is instructive to see that in that country, which does not partake the blessings of a democratic *régime*, but enjoys the privilege of a paternal government, of the total wealth amounting to about forty-five billions, only 2 per cent is vested in the upper classes, 54 per cent in the middle classes, and 44 per cent in the lower classes.

Now, if we admit that capital in its lesser accumulations has been and is conducive to national progress—progress which must include, besides the physical and intellectual, also the moral uplift of man—why does it become dangerous and tyrannical and harmful to the country when concentrated in few irresponsible hands? There can be no doubt that capital and capitalism, based as it is on the institution of private property, has done an enormous lot of good to the commonwealth, as long as it concentrated its activities within the national borders, serving to multiply the values of the native soil. But when capital started to flow beyond the borders of its natural vessel—where it can be checked by competent authorities, and where righteous governments can direct its course to the best ends of all—and when it started to combine with other streams of overflowing wealth from other countries, capital became a wild torrent of formidable force, an *international* power, whose movements are feverish and uncertain and can no longer be guided by established national authorities. Nor are they balanced by weight of international agreement, because there is no arbitrary power strong enough to enforce conciliatory measures, and none elevated enough to enjoy general recognition. International capital is its own arbiter; it is responsible to no one, and its *suprema lex* is to grow and to multiply, ignoring sentimental considerations.

Nobody will deny that the highest aim of capital is to seek profitable investment regardless of national restrictions. And where can profitable investment be better attained than in undeveloped countries, for instance in Asia, having both cheap resources and cheap labor in abundance? Where can the products of such investment be more profitably sold than at home, in highly developed countries, having a high standard of monetary exchange, high life, dense markets, and purchasers able to buy? Spurring, as such investment does, the development of foreign industries, what influence will the emancipation and efflux of capital have on the conditions of the laboring population at home? Taking a concrete case: when textile goods, made in China with American capital, with Japanese machinery, and with Coolie labor, are imported into the United States, being sold on the inland market in competition with home-made goods—as they actually are on the Pacific coast—will this policy, profitable as it is to the capitalist, tend to increase the compensation and protection of the American workman? Will it secure to labor greater safety and stability of employment, will it encourage the creative class of men, the men with ideas, will it provide markets for their goods, and will it help to develop those high-grade products, which are hidden in the American soil, and which only high-class technical talent can lift to light? Surely, since foreign labor is admitted free of duty into the States up to this day, in order to keep wages on a reasonable level, the moneyed interests will find means to convince Congress that the *products of American capital* coming from other lands, must also be admitted free of duty to the American market. Will this natural and steadily growing trend of capital, to produce at low cost abroad and to sell at high profit at home, prove beneficent to national progress? As far as it is given us to see it will not. Rather will it tend to force all the smaller disorganized economic forces in the land, in all lands, to unite in some grand alliance against the oppressive might of capital and to organize their collective strength for the common welfare.

Says William Howard Taft: "A gigantic controversy between capital and labor will decide once for all how capital and labor shall share the joint profits which they create." From our analysis of the situation it will be more a fight between the legitimate power of national governments, representing the interests of the masses, and the arrogated power of international capital, representing the interests of the favored few. There is, indeed, a closer affinity of aims, a firmer alliance of action, traceable today between the great industrial trusts of the different countries, preying jointly upon the world's markets, than there is co-operation existing between the various social strata of one and the same country. The world is becoming an open shop owned by the international association of manufacturers. National borders disappear, and with them all the loftier motives for which they stood.

But it is not only the subjugation of national ideals to international aims that is so much to be feared, but the fact that a small group of selfish men is able to swing, not only the factor of capital, but also the factor of government, setting up nation against nation, and hearthstone against hearthstone. Here is an illustration of this disastrous tendency as it exhibits itself in the commercial dealings of this very day: A small group of American capitalists known under the name of "North Trust," attempted, in times of disorganization of the German market, to buy up one of the fundamental resources of that country, making private contracts for the supply of 320,000 tons of potash per annum, on five years' option; thereby they would gain control of the American market, where about 360,000 tons are consumed annually, thus establishing a practical monopoly in restraint of trade. And this same trust is attempting, further, to engage and play the American Government against the German Government, because the latter has enacted a law (long ago planned and announced to the State Department in Washington), which purports, by the establishment of a national syndicate, to prevent over-production of potash and, for the benefit of the small producer, prohibits squandering irreplaceable resources, of which Germany has no plethora.

It is a most reckless game of concentrated capital, and one which cannot be too severely rejected before the forum of publicity—this attempt to endanger and disturb the friendly relations between two great peoples for the sole benefit of establishing an artificial monopoly on some such commodity and reaping excessive profits from its sale. But it is an instance which shows clearly that national communities must not let the control of capital slip from their hands, lest international complications of the gravest consequences arise, for which corporate capital will not and cannot be held responsible. It is the tragedy of our age, the way this artificial creature of capitalism, in its ubiquity, can forever escape the single justice which the natural individual must face. And it is the duty of every patriotic man, within the borders of his country, to see that the rule of capital is once for all subjected to the rule of government, viz., to the collective force of civic virtue evolved in centuries of nation building.

It is not my aim to throw the search-light of speculative thought on all the various aspects of capital as an international power. Nor do I underestimate, for one moment, the significance of trade and commerce as a peacemaker, bringing the peoples of different countries into closer alliance, urging them to abstain from settling their disputes by organized force, for fear of endangering mutual investments, and even forming combinations for greater security and stability of industries and markets. I have only hinted at some of the *dangers* which arise when national Governments are replaced by international trusts. There is always this one fundamental consideration for advocates of private monopoly power and the rule of capital to keep in mind, as distinguishing between the trust of the few and the trust of the people:—

Government, the great partnership of the State, holding the total assets of society, is a legitimate and recognized authority, established by weight of historical evolution, carrying within it the sanction and inspiration of ages, being free from slavery to instant gain, possessing distance of vision unhampered by special interests, and swinging an instrument of moral force such as no private individual or combination of individuals can ever wield. The other alternative of commercial dealing, private monopoly, or the power of capital—though eagerly bent upon usurping and misusing the *privilege* of government—neglects to fulfill any of its *responsibilities*.

If, therefore, we take into consideration, beside the mere financial aspects of capital as a production factor, its economic, social and moral effects on mankind in general, its influence on eugenics, on the preservation and progress of nations in special, we shall invariably reach the conclusion that capital must be controlled by national Governments and be forced to work for the best ends of the national community, lest it may become a direct menace to the country that gave it birth.

Nobody can contest this argument:—that if the reward of a country's activity in form of wages, and the income from a country's resources in form of dividends, be invested abroad, the productivity of that country will fall short of its potentiality. Considering, in this relation, on the one hand the growth of financial obligation of the United States towards Europe (from which it borrows capital and labor in ever growing quantities), and on the other its waning trade balance; and taking notice, further, of the fact that prosperity in the United States already depends largely on the credit of American securities abroad—it is important to examine somewhat more closely the *rôle* which capital plays in the evolution of industries.

Omitting, at this place, discussion of the more financial aspects of the problem—amount, distribution, organization, and reward of capital in American industries—we confine ourselves to a brief illustration of its genetic-technical effects. In his admirable essay on "National Efficiency," Harrington Emerson has enlightened us upon the economic bearing of industrial production. He has shown in several instances what losses accrue to the national prosperity of a country when quantity of product is placed before quality, immediacy of success before permanence, spasmodic impulse before organized effort. An old but ever interesting argument advanced by political economists will help to emphasize what influence progressive manufacture exercises on the expansion of values gained in a country.

"A pound of cotton, costing at the time this calculation was made (1874), but 13 cents, has been developed into muslin which sold in the market for 80 cents, and into chintz which sold for $4.00." No mention is made here of the far greater values contained in knitted and embroidered fabrics and similar goods, of whose importance for the national industry Schedule I of the new tariff law gives convincing evidence—rates of duty ranging as high as 60 per cent *ad valorem.* Or taking the other important raw material, iron ore: "Seventy-five cents worth of common ore has been developed into $5 worth of bar-iron, or into $10 worth of horse-shoes, or into $180 worth of table knives, or into $6,800 worth of fine needles, or into $29,480 worth of shirt buttons, or $200,000 worth of watch springs, or $400,000 worth of hair springs, and the same quantity of common iron ore can be made into $2,500,000 worth of pallet arbors." And turning to modern times we note again a trace of paternal, because thoughtful, policy on the part of the United States Government, in the make-up of the tariff law, which favors the importation of raw materials but restrains the importation of finished goods, while those machines that serve to encourage the establishment of high-class industries are admitted free of duty.

Or, taking the next important material, coal, which in the United States is almost wholly treated as combustible fuel, instead of being, as it should be, treated as raw material forming the basis of innumerable products. Assuming that the coal contains 5 per cent ash, 20 per cent volatile matter, and 75 per cent pure carbon, we obtain from one ton of coal in the by-product coke oven 2.5 kilogrammes sulphuric acid or 9.7 kilogrammes sulphate of ammonia, 25 kilogrammes tar and the products thereof, 4.5 kilogrammes benzol and 135 gas-horse-power hours; while the remaining 750 kilogrammes of coke, together with the ore in the blast furnace, yield 800 kilogrammes pig iron, 1,000 to 1,500 kilogrammes slag (used for making cement and bricks), and 600 gas-horse-power hours. It is evident, therefore, that when coal is burnt directly in the furnace all the valuable by-products are lost to the national industry—and it is further evident, from this technical deduction, that capital which shrinks from financing inland enterprises of a higher order, involving risk, and prefers to settle in the more profitable (because established and broadened) channels, producing raw materials or half-finished goods, or staples of some kind abroad, is far from conducive to national progress. We may substantiate our former argument, therefore, by saying that capital, being the product of the industries of a country, must again be invested in that country's industries, in order that the people may have employment and be encouraged to strive on.

Now if by legal action we can move capital to seek investment in the home industries, thus serving to build up the inland market, we are confronted by another question, quite as important as the first: Is the modern form of capitalistic organization, concentration of production and elimination of competition, favorable to industrial progress? Even if we were to admit that the world's productivity is governed by the "inexorable law" of supply and demand, it is evident that the mutual relation of these two factors has been entirely altered, even reversed, by the evolution of industries. While in former years needs and necessities actually did exist, and individual wants were met by the supplier—who had to conform his output to the taste of the purchaser—it is the merchant today, the manufacturer, the enterprising capitalist who, by show and advertising, incites desires, awakens needs, changes luxuries to comforts and comforts to necessities, in order that he may profit from the sale to consumers.

Goods are made, not to order, but ready for use; fashions are dictated by manufacturers; and markets, if not available, are drummed by agitators and salesmen. Supply precedes the demand, production outweighs consumption. The price of commodities is no longer the *natural resultant* of these two forces, but is an *artificial entity,* fixed by the storing power of capital. The ability of capital, by means of money and machinery, to buy up and retain goods at will (for example, to purchase and preserve practically the entire supply of some commodity at far less than its actual value), has placed markets and consumers at the mercy of capital. Says Dr. Arthur Twining Hadley:

> For at least fifty years we have been developing our skill as producers much more than our intelligence as consumers. We have been increasing our industrial output without correspondingly improving our civilization. I wish I could feel sure that the wisdom with which we spend our money had increased correspondingly. Intelligent consumption is a neglected art. The individual buys, not what he wants, but what he sees most prominently advertised. . . .

We note then, as a direct result of the reign of chaos or extreme individualism which set in with the change of the Washingtonian to the Jeffersonian principles, a reversal in the mutual relation of the chief factors of industrial production, which was accelerated, even, after the close of the Civil War, by the opening of the South. Grown on the basis of free competition, capitalism succeeded soon in gaining unrestricted sway over the affairs of the country and, today, has almost reached the limits of its usefulness as an instrument of national progress, thus negating its own existence.

Large-scale production has entirely altered also the *social* conditions of industrial enterprise. I quote William Clarke:—

> The old personal relation between the workers and the employer is gone; instead thereof remains merely the cash nexus. To secure high dividends (for his employers, the stockholders) the manager will lower wages. If that is resisted there will probably be either a strike or lock-out. Cheap labor will be, perhaps, imported by the manager, and if the work-people resist by intimidation or organized boycotting, the forces of the State (which they help to maintain) will be used against them. In the majority of cases they must submit.

Not an unfair picture of the relation of capitalist and workmen today. We do not go so far as to say, with the Socialists, that there must cease to exist an idle class of society, whose economic function is simply to furnish capital and live on the interest. We do not say either that capital must be held and operated collectively for the equitable good of all. But we do say that *capital must be the servant, not the master, of the national community.* With conditions as they obtain today—in the United States more so than anywhere else—the mere *forms* of freedom (of competition) remain, but monopoly renders them nugatory.

Monopoly, the great discourager of effort in trade, manufacture, and profession, will dictate the technical methods to be followed, thereby suppressing individual aspirations. A few great corporations will buy up the highest grade of human talent, inventive, literary, mechanical, and will keep it latent or, at least, barren of creative work—as long as people are content to put up with "standard goods." There is no alternative left to unsatisfactory dealing. The "free" people in America not only must buy what manufacturers deem profitable to sell on their protected market, but they must pay any price which the combination of dealers agrees to charge. In fact, the prices which consumers have to pay for their goods in the States are, on the average, 15 per cent higher than are those at which the same class of goods is sold abroad. Nor is their quality any better. On the contrary, they must often pay the highest price for the poorest service.

This deplorable result, though it cannot in justice be generalized, is certainly the direct opposite of what scientific progress, in a democratic community, should bring about. And here is where this lamentable plague of commercialized endeavour is again wedded to the prime cause of capitalism and monopoly, which is threatening us today in all progressive countries. The technical forces in industrial production are being overruled by the financial forces, by greed, ignorance and the rule of thumb. The commercial success of an enterprise on the levelled markets depends far more on the ability of the sales department than on the real economic, technical, artistic merits intrinsic to the products thereof. There is no management so alert, so watchful, so free from slavery to instant gain, that it can direct the affairs of our gigantic modern combines in the way of intellectual, social, uplifting effort, away from worship of mere wealth.

Summing up we may say: While value and quality of goods grown in the hot-house of private monopoly need not of necessity be inferior, and may in some instances be superior to others, their competitive strength on the world's markets will in most cases be lower, and their price on the home market higher, than they would be under a natural competitive *régime,* which brings out the best in civilization and man and, certainly, seems the only *régime* tolerable in a democracy. But as competition led to over-production and therefore to the cutting of profits among capitalists, it had to be replaced by corporate business, by the concerted action of wealthy individuals and, finally, by the rule of private monopoly which, today, is the only "adequate rule" in the American Commonwealth. Nevertheless it is not adequate to protect the country against waste and corruption, against depression and panics, afflicting business every four or five years to the detriment of the people.

Do the pioneers of *progress,* do engineers, do artists, do literary men, do all progressive workers, realize that the monopolistic order of society established today contains in itself all the dangers against which the fathers fought? That private monopoly is the source and sustenance, not only of bad government but of national stagnation, and if permitted to continue still farther must ultimately destroy the very foundations upon which the commonwealth rests? Are we aware of the fact that our professions, by the rule of monopoly, are being degraded to a pitiable rank; that we are becoming the eunuchs of a hybrid civilization, the tools of *mammon,* which in its morbid zeal for uniformity, for tonnage, for immediacy, is reducing the whole world to one dead level, stifling originality, quenching individuality, crushing out the most wonderful of faculties—the creative faculty of man—beyond a possibility of resurrection, and forcing every one of us to fit himself to its Procrustean bed!

THE NEW ERA IN ELECTRICAL ILLUMINATION.

By Rollin W. Hutchinson, Jr.

III. GLOWER AND VAPOR LAMPS.

Mr. Hutchinson's review of modern illuminating equipment, from the viewpoint of installation and operating qualities, efficiency, and relative cost, is addressed primarily to the user and consumer. He began the discussion in our December issue with a study of metal-filament lamps. The January portion dealt with luminous and flaming arcs. The present part concludes the series.—The Editors.

THE Nernst Lamp, which is now too well-known to warrant detailed discussion, is essentially a "glower" lamp, but it has some of the characteristics of the enclosed-arc lamp in that its operation is partly thermal and partly electrolytic. As manufactured at the present time the glower consists of a combination of the rare earths of volcanic production, including zirconium, woehlerite, gadolinite, euxenite, yttrotitanite, yttrocerite, samarskite, cyrtolite, aloite, endialyte, polykras, and kataplite. Nernst lamps are constructed in either single-or multiple-glower form.

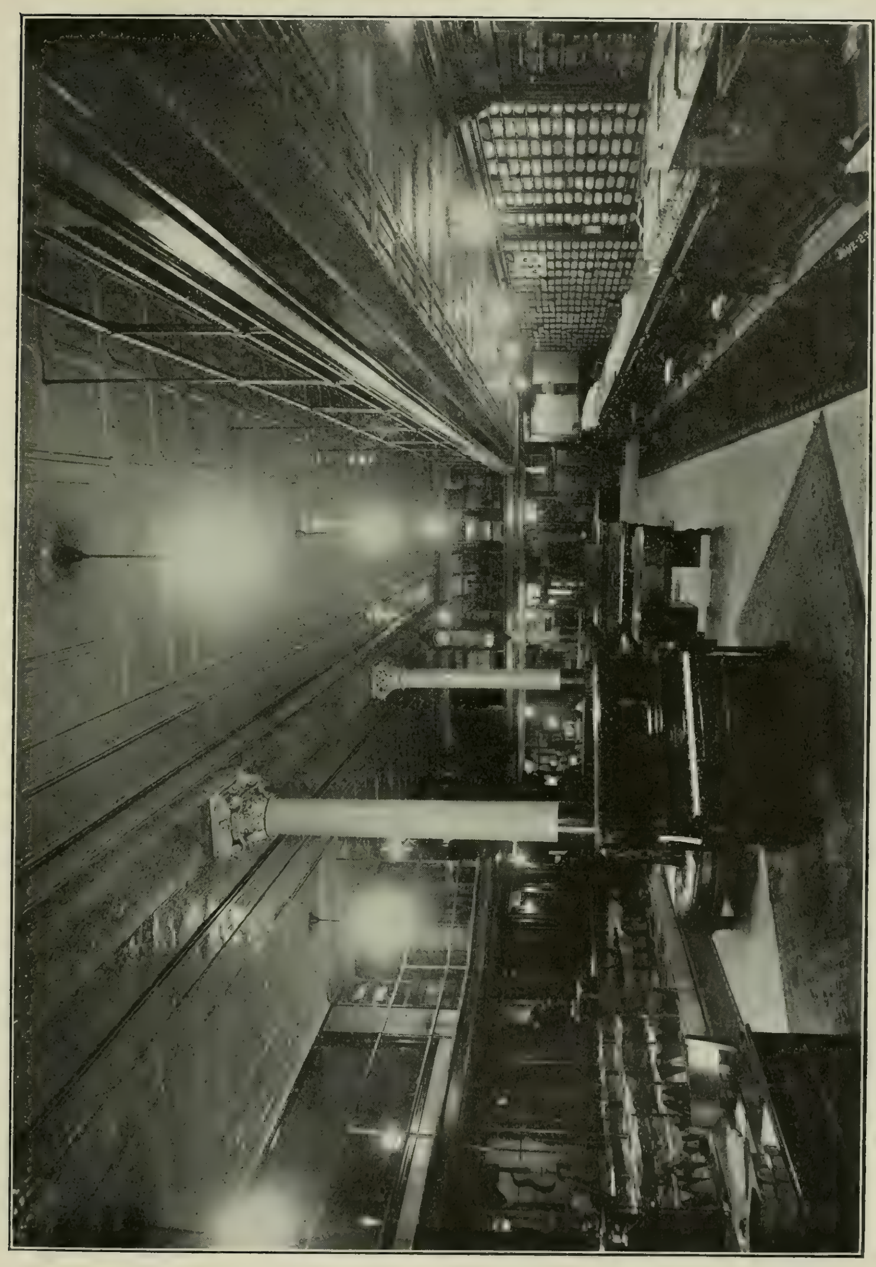
Westinghouse-Nernst lamps are made in six units for use on both alternating and direct current of 220 volts, and three units for both alternating and direct current, 110 volts; for indoor and outdoor service. These are commonly termed 88- 110- and 132-watt single-glower, two- three- and four-glower lamps.

The normal range of operation of standard glowers varies from 200 to 260 volts for 220 volt ratings and 100 to 130 volts on 110-volt rating. The adjustment of Nernst lamps for use on circuits of various voltages is effected in the holder, and merely requires the employment of different glowers.

The efficiency of Nernst lamps increases with the number of glowers (up to the number of glowers practicable to use) because of the higher temperature gained from the closeness of the lighting units.

Color and Distribution of Light from Nernst Lamp.

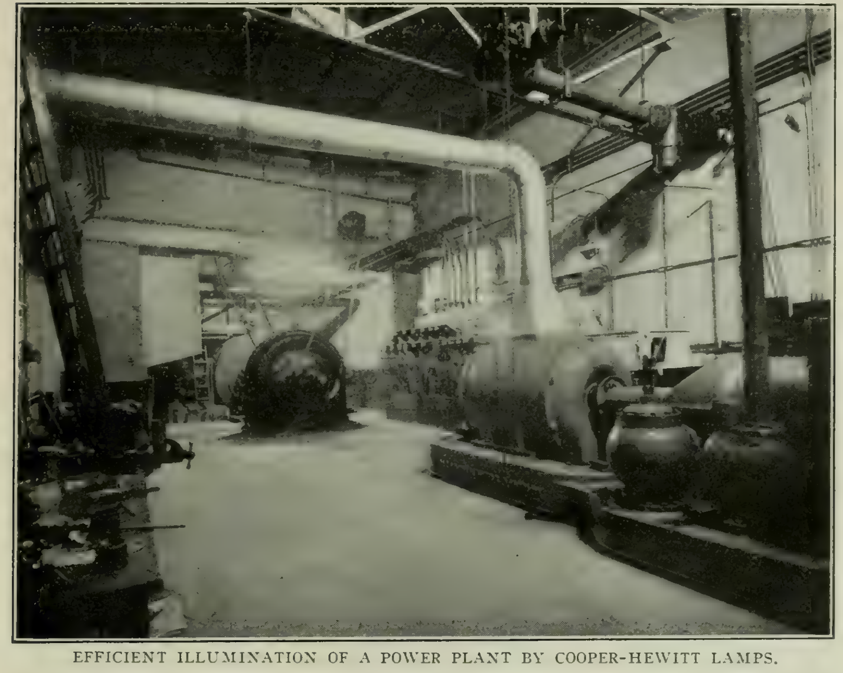
The color of the illumination from the Nernst lamp is a pearly white, yet it possesses sufficient softness and warmth to render it very serviceable for a variety of illuminating work. One of the most notable installations of Nernst lamps in America is that of the large department store of Marshall Field & Co., Chicago, in which 6,000



TYPICAL WESTINGHOUSE NERNST ILLUMINATING INSTALLATION IN A MUSIC STORE.

A SIOUX FALLS DEPARTMENT STORE LIGHTED BY WESTINGHOUSE NERNST LAMPS.

Nernst lamps of various sizes are employed, mainly of the two- and three-glower type. This installation replaced nearly 58,000 incandescent electric lamps.



EFFICIENT ILLUMINATION OF A POWER PLANT BY COOPER-HEWITT LAMPS.

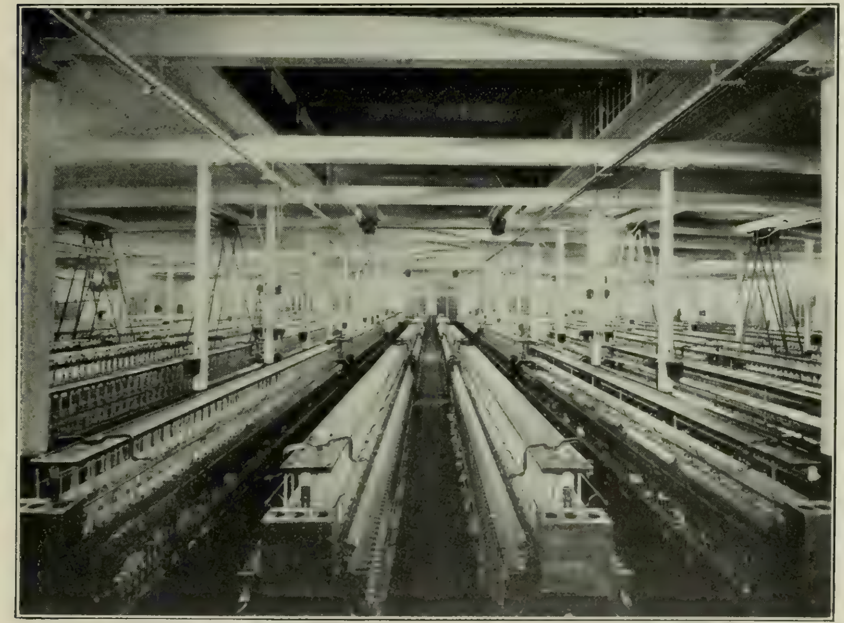
The Nernst lamp has been developed with a view of making its maximum intensity of illumination in the vertical direction. The most serious disadvantage of the Nernst lamp, which has to a large degree prohibited its more rapid introduction, is the trouble of retrimming or replacing the glowers, requiring as it does one experienced in the care and maintenance of this *special* lamp. For this reason the Nernst lamp is not extensively employed in residence lighting, its principal field of service being in large installations—in general office and department-store illumination.

VAPOR LAMPS.

Vapor lamps have a constantly growing field of usefulness and their gradual perfection for utilization in now restricted conditions of lighting service is promising. The best known types of vapor lamps are the Cooper-Hewitt and the Moore light. The former, which depends for its operation on the ionization of mercury sealed in an exhausted glass tube, is the invention of Dr. Peter Cooper

ILLUMINATION OF THE FALK FOUNDRY, MILWAUKEE, BY COOPER-HEWITT LAMPS.

Hewitt. One end of the tube is made in the form of an oval which is filled with mercury. Platinum terminals are sealed in each end of the tube for admitting electric current, the passage of which vaporizes the mercury into a stream of high conductivity. The conducting vapor is said to be "ionized" by the current, the two kinds of "ions" being termed, according to the terminal at which they are evolved, positive and negative ions. Luminosity of the lamp is produced by the incandescent particles in the vapor stream, the hypothesis being that the high temperature of the infinitesimal particles is due to the collision of the positive and negative ions travelling at enormously high speed. Although the temperature of the particles of matter in the tube is prodigiously high, the particles are so minute that the ultimate temperature of the lamp is reasonably low. Light is emitted in uniform intensity from every portion of the tubes, and there are no dazzling or bright moving spots.



A TEXTILE MILL UNIFORMLY ILLUMINATED BY COOPER-HEWITT LAMPS.

The chief field of usefulness of the mercury-vapor lamp is in a certain class of industrial lighting where the accurate determination of color value is not necessary. In recent years the Cooper-Hewitt lamp has been extensively adopted for the lighting of large machine shops and foundries; in business offices; in the press and composing rooms of many large publishing houses; in railroad repair shops; in pier sheds and freight houses; in textile mills; in automobile garages and shops; in piano and organ factories, leather and paper mills, glass and rubber factories, copper and sugar refineries, hat factories, navy yards and wood-working plants.

The Quartz Mercury Vapor Lamp.

This is a specialized form of mercury-vapor lamp in which fused quartz is employed as a tube to withstand the very high temperatures at which the lamp operates. The vapor pressure at which the quartz lamp operates is about one atmosphere, the consumption of energy being about 0.25 watts per candle-power measured perpendicular to the axis of the tube. The arc in the quartz lamp is very much shorter than in the low-pressure mercury lamps, and as a result the dimensions of the tube required are small so that it is practicable to place it in a case and globe so as to resemble an arc lamp. Most of the quartz lamps at present are made for operation at voltages of 220 and 110 volts and are designed for currents of 2.5 to 4.1 amperes, according to size and voltage.

The quartz lamp is simply an intense mercury arc, mercury vapor being forced to high temperatures and powerful luminous intensity by concentration in a working tube of barely more than capillary dimensions. For instance, the luminous tube of one of the latest types of quartz lamps is about the size of an ordinary lead pencil and emits from 1,200 to 3,000 hefner-candles with an energy consumption of about one-quarter watt per candle. This consumption of energy is that of the voltage at the tube terminals which is about 85 for 100 to 130 volts of supply and 160 to 180 for double this voltage. Hence the efficiency based on the voltage of supply, including ballast, is not quite as good, being about 0.37 watt per candle, which, however, compares very favorably with that of the flaming arc.

Thus far the quartz lamp has only been used in Germany, chiefly for display purposes in very much the same manner in which flaming arcs were at first used in the United States. The properties of the lamp, however, are such that it is not unlikely that in time it will be seriously considered for general outdoor lighting.

The Moore Light.

This invention of Dr. D. McFarlan Moore is similar in some respects to the mercury-vapor light in that it consists of a light source of larger area in the form of tubes of hollow glass varying from 40 to

THE MOORE LIGHT FOR INTERIOR ILLUMINATION.
Above, a clothing store lighted by the white Moore light. Below, banquet room for Taft dinner, Passaic, lighted by yellow Moore light.

over 200 feet in length, the tubes being exhausted of air and filled with a conducting vapor. The conducting medium is either nitrogen, which when the tube is electrified emits a yellow light and gives the highest efficiency; carbon dioxide, which emits a white light analagous to daylight; or plain air, which makes the color a pale pink tint.

The Moore vapor light possesses a number of advantageous features, chief of which are its *daylight color value* and its low energy consumption for a given illuminating effect. Tests have shown the Moore lamp to have but one-fifth the energy consumption of carbon incandescent lamps in 140-foot lengths. Operating with carbon-dioxide gas a 211-foot tube light gives an efficiency 1.5 times that of arc lamps of the enclosed alternating-current type. The specific energy consumption of the light is 2.84 watts per candle-power for tubes 40 feet long and 1.59 watts per candle-power for 220-foot tubes, operating on nitrogen gas. The average candle-power of the Moore Light is about 10.5 candle-power per foot of length. Under good conditions the life of the tube may be over 10,000 hours.

The Moore light is the nearest approach yet made to the much desired cold-light as exemplified in Nature by the firefly, and in the matter of diffusiveness, color, steadiness, efficiency, and safety is on a parity with a number of other electrical illuminants; and it is unaffected by heat, cold or moisture. The lamp is of low intrinsic brilliancy, emitting a soft, mellow light with no bright spots to blind the eye, hence is very suitable for illuminating auditoriums, theater and hotel lobbies, stores, etc.

Despite the above mentioned advantages, the Moore light possesses several obvious disadvantages which make against its utilization on an extensive commercial scale. Chief of these objections are its individuality, imperfect diffusion, fragility, and inefficiency as compared with the tungsten or flaming-arc lamps. Its color value is also not that of the continuous spectrum of natural light, but is the banded spectrum of gases. Its greatest disadvantage is that of not being a divisible light; a switch is thrown and all the light is turned on; with the Moore light we cannot have a little light here or there as we need it. The individuality of the light makes it necessary, in the character of lighting for which it is suited, to supplement it by some other system of lighting which has the feature of divisability. Again, the fragility of glass makes it impracticable to trust the lighting of an interior of much importance entirely to a long rectangle of glass tubing. Moreover, the breakage of the tube, especially in places hundreds of thousands of miles distant from the factory in which the light is made, and which possesses the only workmen capable of doing delicate glass plumbing, would put the artificial lighting of a building, if done entirely with Moore tubes, out of service for days or weeks.

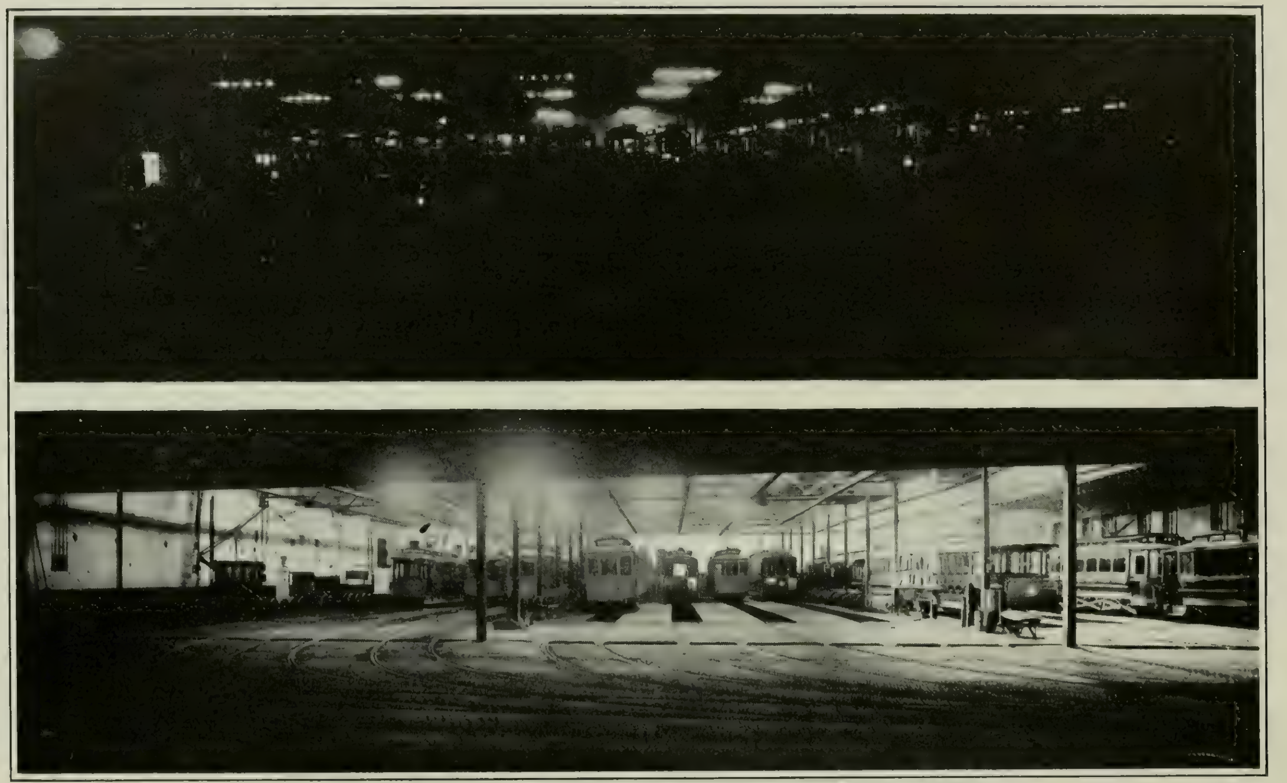
At the present time the Moore light is also an exclusively alternating-current lamp, and when it is used on alternating current of a commercial frequency it produces a marked flickering on objects moved quickly in the light. In cases where the objects must be handled with rapidity this is a serious practical disadvantage of the light. Another serious detriment of the lamp as a result of its indivisibility is its unsuitability for localized lighting. Where localized or concentrated lighting is desired rather than distributed lighting, the economical lighting of certain portions of the room instead of the uniform illumination of the entire room—a divisible illuminant must be used.

The history of the Moore light is, however, young, and the indefatigable efforts of the inventor in overcoming its shortcomings augurs well for its future as one of the foremost electrical illuminants.

SOME POINTS TO BE OBSERVED IN ARTIFICIAL ILLUMINATION.

The artificial illumination of the majority of rooms is accomplished by a combination of direct and indirect lighting; that is, some light comes directly from the lamps and from the reflectors over the lamps, and some is received from the walls by irregular or diffused reflection. If all of our light comes directly from the lamps and reflectors and none from the ceilings and walls by reflection, there will be many sources of light in a room, if sharp, annoying shadows are to be avoided. But in the case of a room with perfectly white walls, the amount of light received from the walls and ceilings by reflection is so large a percentage of the total that shadows are not so disagreeable. The first step in planning the illumination of any room is a careful consideration of this problem of shadows.

The second important step is the placing of the lamps with reference to the eye. A fundamental fact in artificial lighting of interiors is that the less exposed the lamps are to the direct view of persons in the room, the lower the actual illumination required because the exposed lamps exercise a well-known blending effect which causes surrounding objects to appear less distinctly visible than if the lamps were shaded. The judicious importance of these fundamental facts physiologically must, however, be often ignored when we consider illuminating efficiency aside from the effect on the eye and the overcoming of too sharp shadows.



A LARGE ELECTRIC CAR BARN, UNDER TWO SYSTEMS OF ILLUMINATION.

Above, the old method—carbon-filament lamps badly arranged. Below, modernized by Cooper-Hewitt illumination.

The word efficiency is applied so loosely in the technique of illuminating engineering that it is difficult to define it exactly, since so many elements enter into it. Thus the total amount of light emitted by the lamps in a room may be measured and the efficiency of illumination determined from this basis, or the total amount of light received on a plane 30 inches from the floor over the entire room may be measured and the percentage of the total light receivd on the plane may be called the efficiency of illumination. Neither of these measures of illuminating efficiency, however, makes allowance for the fact that the illumination may be received in such a way that it is very unsatisfactory to the occupants. For instance, a room may be very efficiently illuminated from a purely technical viewpoint by suspending lamps at frequent intervals on drop cords and enclosing the lamps in an efficient type of reflector (mirrored) which would cause all of the light to be thrown down onto the level of chairs and tables. Such a method of illumination would, however, be crude and unsatisfactory since a room so illuminated would be very fatiguing to the eyes, and from an esthetic viewpoint would be barbarous, for the reason that the contrasts would be too great, the upper part of the room being in semi-darkness while the lower part would be brilliantly lighted.

The proper and efficient lighting of interiors from both the technical and physiological viewpoints requires a certain satisfactory proportion between the light thrown upwards and that cast downwards. Practical illuminating engineers are agreed that in the majority of rooms, both large and small, comfortable and efficient results are obtained when from 25 to 35 per cent. of the total light produced is directed toward the ceilings and walls, the remaining 65 to 75 per cent. being directed downward for the direct use of the occupants. This is a general rule, subject to modification in cases where for special reasons more illumination is required on ceilings and walls. But this relative ratio is sufficient to define decorative effects on walls and ceilings properly while also maintaining the illumination on walls and ceilings at a low enough value to make the lower part of the room appear comfortably lighted to the persons reading or working therein.

In most instances where a room is poorly lighted it is due to the fact that more than 25 to 35 per cent. of the total light is thrown on the walls and ceilings. It is an indisputable fact that so many people have been led to believe by charlatans and ignorant inside wiremen that walls and ceilings must be highly illuminated to produce a good lighting effect that they continue to have their residences lighted so that a larger proportion of light is cast on walls, etc., than is obtained from daylight illumination. Thus during the day the lower part of a room is almost invariably lighted to a higher intensity than the upper part, which condition is accepted as proper. Immediately artificial light comes on the conditions are reversed—the upper part of the room being illuminated more than the lower part, provided lamps are suspended high and proper provision is not made for directing the light downward.

These essentials lead to the question, how do modern lamps and reflectors conform to these requirements? As a general proposition it may be stated that all incandescent lamps if hung pendant and equipped with properly designed opal or prismatic reflectors which come down even with the tip of the lamp approximate these desiderata.

Until the past few years much of the illumination of interiors was designed by rule of thumb and haphazard methods of tyros styling themselves illuminating engineers, any arrangement of lights sanctioned by the owner of the building being considered good enough if the shibboleth of these tyros—"light, more light," was conformed to. Sad to say many of the crude and barbarous illuminating effects of the past (and unfortunately of the present also) were approved by some of the largest and most progressive of electric-lighting companies in the United States, any improperly designed lighting installation being winked at provided it brought in what the company considered sufficient revenue. Indeed, it was the boast of one of these large retailers of light that "it had forty illuminating engineers in its employ." The company, however, failed to state the qualifications their retinue of illuminating engineers possessed to deserve this most important appellation.

Happily the day is passing when illumination is based on empiricism and guesswork. The dawn of a new era in illumination is upon us, introduced by the newer types of high-efficiency lamps, and aided and furthered by the co-operation of the professional illuminating engineer, the progressive architect, and the modern electric-lighting corporation. Illuminating engineering is becoming more and more a fine art—an art in which it is everywhere recognized that technical training, experience, and esthetic sense are required.

MAIL-HANDLING PLANT AT THE NEW PENNSYLVANIA TERMINAL.

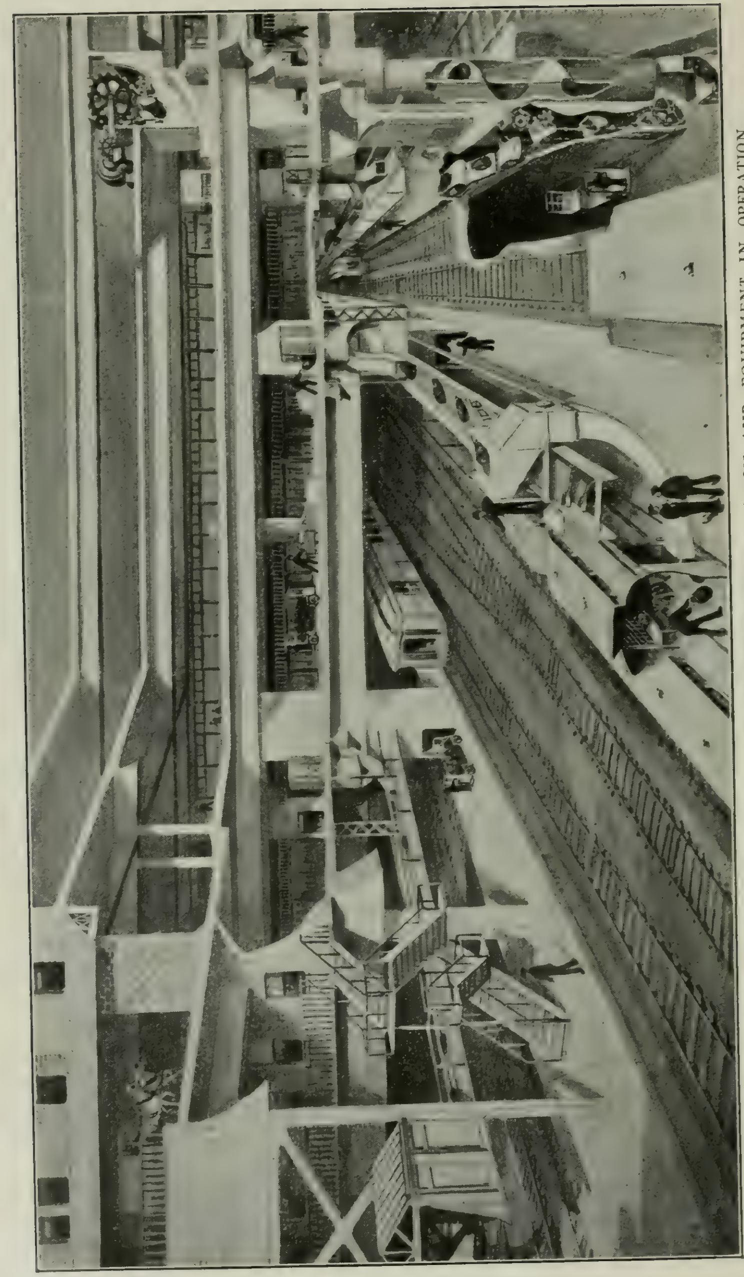
By Joseph B. Baker.

Mr. Baker condenses into concise form a practical description of a unique mechanical-transport installation, electric-motor operated, and embodying most interesting features of adaptation to difficult conditions of quantity, space, time, and material.—THE EDITORS.

ABOUT forty per cent of the total outgoing and incoming mail of New York City is handled over the lines of the Pennsylvania Railroad System. This mail, amounting in round figures to from 250 to 300 tons a day, is now concentrated at the New Pennsylvania Terminal, situated in the heart of Manhattan. In order to handle such a mass of mail an elaborate and unique mail-handling equipment was installed, involving the solution of a peculiar problem of mechanical engineering.

On November 27 last, the Pennsylvania Railroad in New York City, which had been operating partly via Hudson River ferries and partly by electric trains running through its Hudson-River and East-River tubes to its new terminal on Manhattan, discontinued this transition arrangement, and the vast steel and granite station, occupying the 800 by 434 foot area between Thirty-first and Thirty-third Streets and Seventh and Eighth Avenues, took up the service. On the same day a partially completed post-office building, occupying the site west of the station, was put into service to handle the mail. This building is being erected by the Government, and will be completed in 1912. It fronts on Eighth Avenue and extends from Thirty-first to Thirty-third Streets and about half way from Eighth to Ninth Avenues, and will be about 375 feet square. A private street runs along the west side of the building, connecting Thirty-first and Thirty-third Streets, and that side of the building is designed with an inner covered driveway 300 feet long and 32 feet wide and with an adjoining mailing platform 312 feet long and 35 feet wide for loading and unloading mail wagons.

Both the Pennsylvania Station and the new Government post office building span the tracks of the Pennsylvania Railroad, 50 feet below the street level. To provide for the railway mail service, the westerly end of the post-office building has been finished in a temporary manner, enclosing a space on the basement level nearly 360



A GENERAL PICTORIAL SECTION OF THE MAIL-HANDLING INSTALLATION AND EQUIPMENT IN OPERATION.

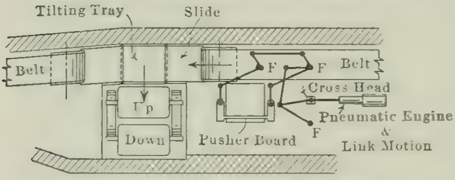
feet long by 170 feet wide, making provision for a large trucking plaza, offices for officials and clerks, and ample space for a complete railway-mail post-office equipment and a large force of postal employees. The mailing platform and driveway on the floor above the basement are also completely housed.

Provision had been made of the usual facilities for handling mail bags, substantially as found in all modern railroad stations. Four large plunger elevators provide connections between the mailing platforms and the basement and train-platform levels. Four train platforms and six tracks under the western end of the post-office building, offering room for a maximum of 26 mail cars at one time, have been set apart wholly or partly for the railway-mail train service. All four train platforms will handle mail departing from the station. The southerly platform is specially arranged for receiving the incoming train mail from the South and West. Aside from the heavy incoming and outgoing mails handled on these tracks, there are other mails, light but frequent, for despatch by trains on other tracks. These mails will be sent through spiral chutes or elevators down to a trucking subway 12 feet wide, extending eastward under the tracks nearly 1,000 feet, provided with transverse branches extending north and south, and connected with the various platforms by means of elevators. To facilitate the rapid transfer of mail from point to point on the various levels, from one level to another, and through the elaborate system of subways, a large number of electric motor trucks have been provided, each having a carrying capacity of 4,000 pounds, and the plunger elevators, between the different levels, have been designed with sufficient size and capacity to raise and lower these loaded trucks.

Such facilities, however, are not of themselves adequate to provide for the prompt handling and despatch of the enormous quantities of mail—250 to 300 tons, as already mentioned, comprising from 12,000 to 16,000 bags weighing from a few pounds to 300 pounds apiece—which daily depart from, and arrive at, this station. Since the trains are moving quickly in and out of a very restricted underground trackage network, this dense mass of mail must be handled with great celerity. Therefore a mechanism had to be devised which would be not only capable and reliable in operation but would embody such design as to go into a space cramped in the nature of things by the building structure itself—the latter being virtually a monumental traffic gateway straddling the underground railroad tracks. Further, this mechanism had to be free from all possibility of causing delay to train movements, or interfering with lines of sight on signals. In other words, a complex conveying machine for executing one of the primary functions of a railroad station, mail handling, must be installed in waste underground space that had already been reduced to the lowest practicable amount by the railroad and building architects.

This problem, in which the Post Office Department was so vitally interested, was taken up by committees representing the railroad, the architects (Messrs. McKim, Mead & White), and the railway-mail department of the United States Post Office; and it was finally entrusted to Mr. J. E. Woodwell, of the firm of Marks & Woodwell, consulting engineers, New York City, who had already demonstrated special ability and resourcefulness in other Government work, notably in the Treasury Department.

The unique engineering character of the mail-handling work, and the local restrictions, required a radical departure from conventional conveying-machinery design. In many parts of the system success or failure absolutely hinged upon apparently minor points. For example (and anticipating a little), in the mechanism designed to deliver incoming pouches to the underground conveyor-belts, at the loading stations, it was found necessary to give the pushers a peculiar motion—a quick start which gathers up the pouch smartly, and a slowing down at the end of the travel as the pouch is delivered to the belt. This motion was obtained by a toggle-linkage, as indicated in one of the illustrations.

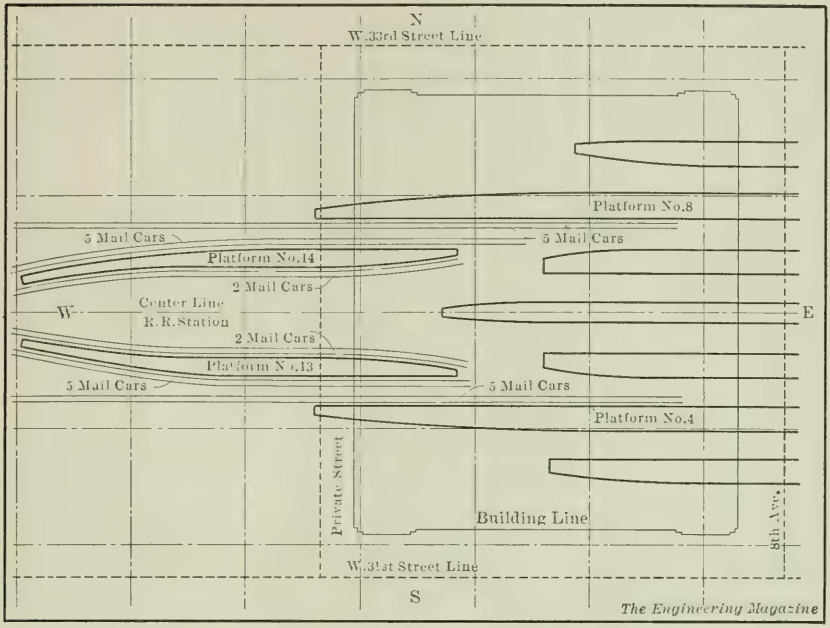


The Engineering Magazine

PNEUMATIC BELT-LOADING MECHANISM FOR INCOMING MAIL.

Mr. Woodwell's solution of the task is already proved a success in the uninterrupted facility with which the mails have been handled from the start. In this system the intelligent application of electric power has increased the efficiency of mail handling and car utilization and saved much manual labor, notwithstanding the limited amount of underground space that was available for its installation. Moreover, the distribution of mail matter effected by the system is so complete that much of the sorting and re-handling formerly done on the trains *en route* is eliminated. Practically the entire cost of the installation was assumed by the railroad company and amounted to nearly $300,000.

Two classes of machinery are provided, one for handling the outgoing and one for handling the incoming mail. The mail to be dispatched on outgoing trains arrives at the station in wagons, which are unloaded at the mailing platform. Here the mail pouches are sorted, some of them being sent to the basement level through spiral



The Engineering Magazine

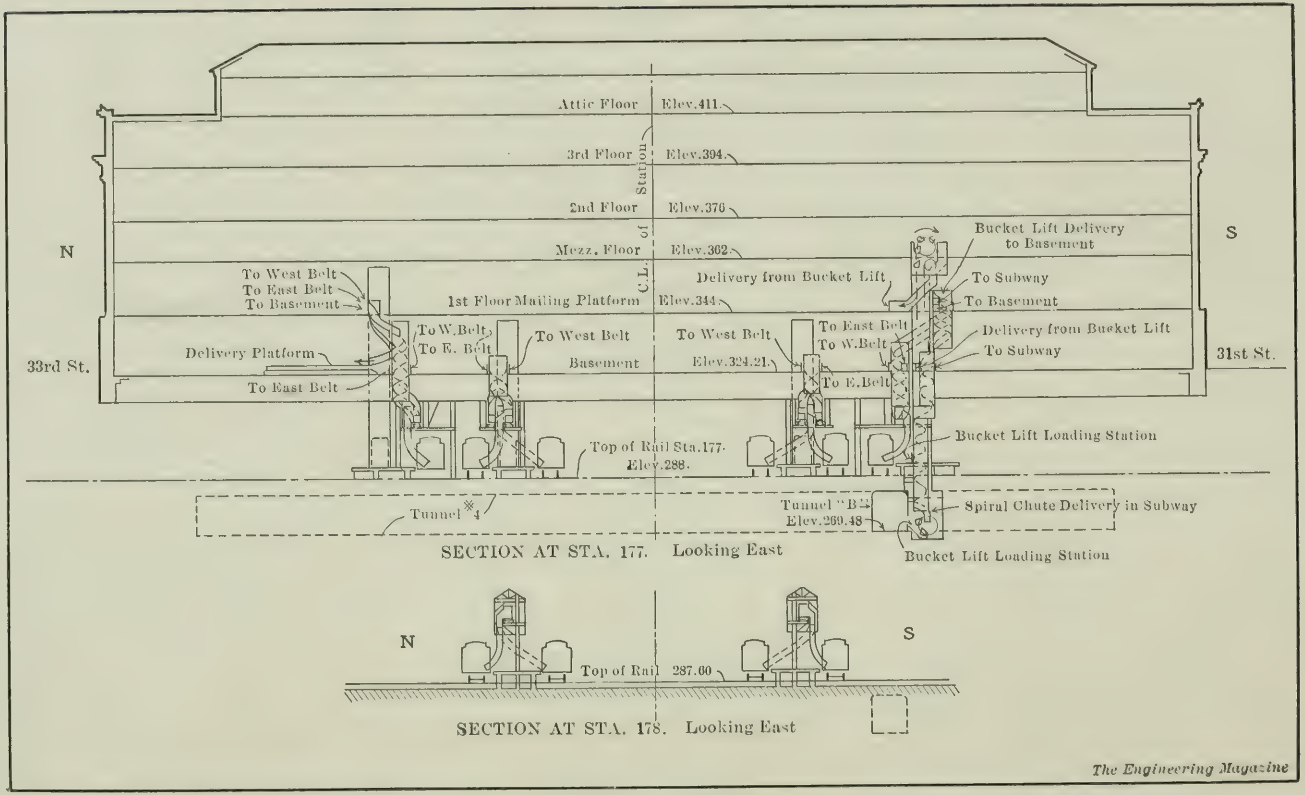
THE FOUR PLATFORMS AND SIX TRACKS DEVOTED TO POSTAL SERVICE, NEW PENNSYLVANIA RAILROAD STATION POST OFFICE.

chutes, where they are opened and the contents redistributed and finally repouched; and the reassembled pouches, together with the unopened pouches, are then fed into spiral chutes, which deliver them to conveyor-belts located at the track level above the mail cars.* The belts are provided with automatic trippers or unloading mechanisms, which may be set opposite the door of any of the cars of the mail train, thus automatically unloading and transferring the mail through vertical slides directly into any one of the mail cars for which the apparatus has been set. Two belt-conveyers are provided over each of the four mail-track platforms, one belt extending east and one west of the connecting spiral chutes, which are constructed with separate compartments, one for each belt. By this means, two mail cars at each of the four track platforms may be loaded simultaneously.

The speed of the apparatus may be estimated from watching the loading of one of the heavy Western mail trains which carries the early morning newspapers and steamer mail, together with an enor-

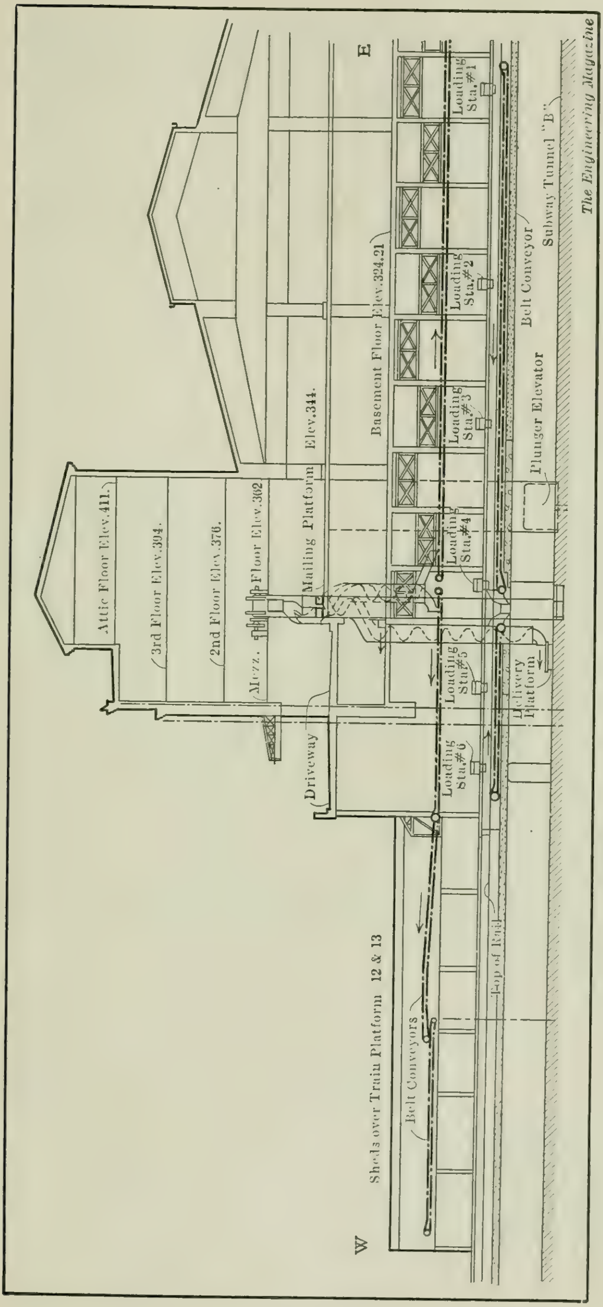
---

* There are no pneumatic tubes for mail as yet installed in the new post-office structure at the Pennsylvania Station; but it is the intention of the Post Office Department to have a connection made between the "Times Square" postal station and the new post-office structure as soon as practicable. This branch line will establish connection with the pneumatic tube service of the city, which covers, with few exceptions, all postal districts south of 125th street.



The Engineering Magazine

KEY TO ARRANGEMENT OF MAIL-HANDLING MACHINERY, NEW PENNSYLVANIA RAILROAD STATION POST OFFICE.



SECTION AT STA. 1+005. LOOKING NORTH.

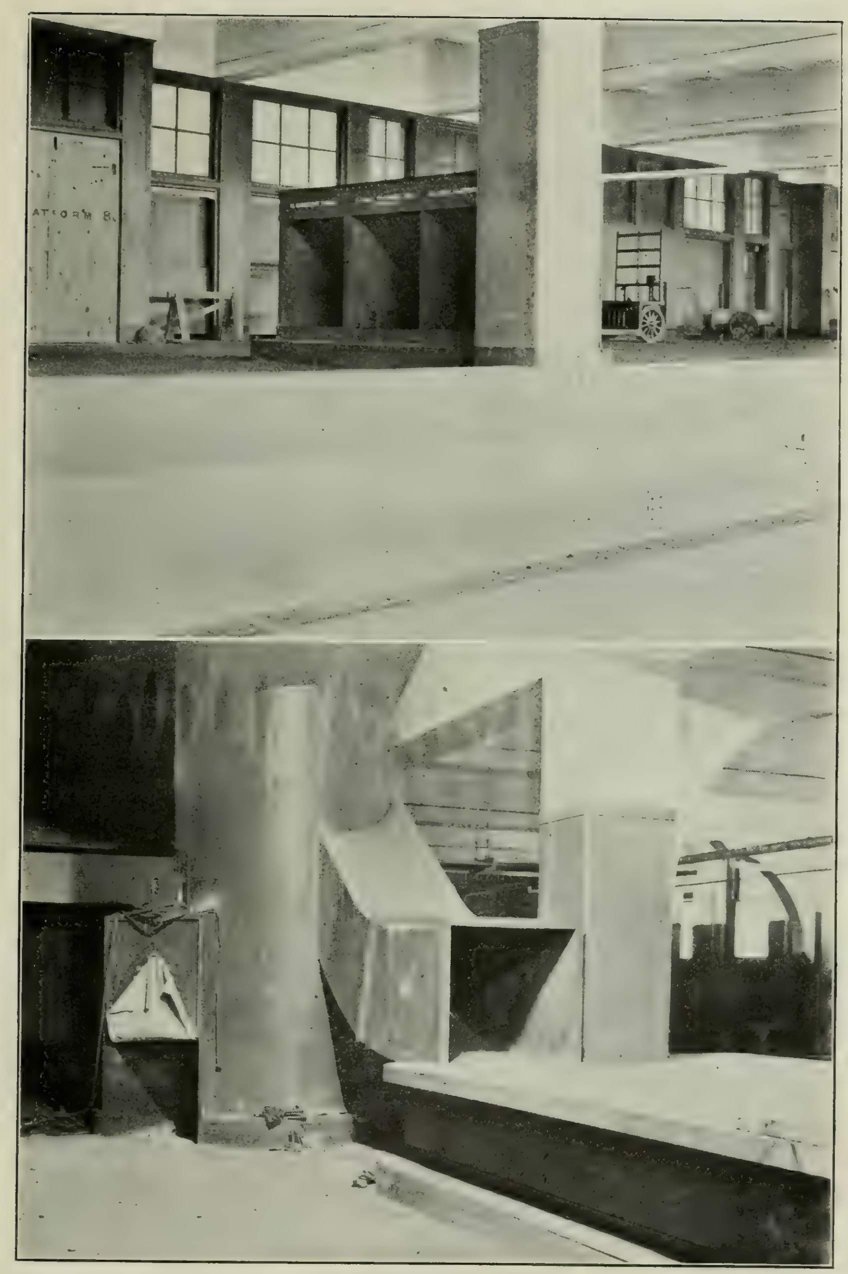
mous quantity of first-class mail matter to Western points, amounting in all to over 50 tons, comprising 1,200 to 1,500 mail pouches. Much of this mail is resorted and segregated for the different cars and despatched from the station in less than three hours, over 25 tons being handled during the last hour, and the bags being frequently unloaded into the cars at the continuous high rate of one every second. From the spiral-chute entrances the bags descend through the winding convolutions, and continuing their journey along the rapidly moving belts, finally emerge at the door of the car, almost noiselessly, the entire journey occupying about 30 seconds. To handel the incoming mails, openings are provided in the train platform into which pouches are thrown from the arriving cars. The mail is then transferred from these receiving hoppers or "loading stations" by means of belts located below the platform floor. A complex mechanism operated by compressed air is designed to feed the pouches on to the belt at suitable intervals, so that the pouches may arrive at the end of the belt at the proper time to be mechanically transferred to the buckets of a bucket elevator, by means of which the bags are elevated to the basement and mail-platform levels of the building. The belts and the bucket elevator are all operated by a single electric motor.

LOOKING EAST FROM TRACK LEVEL, SHOWING NORTH OVERHEAD CONVEYOR COMPLETE.

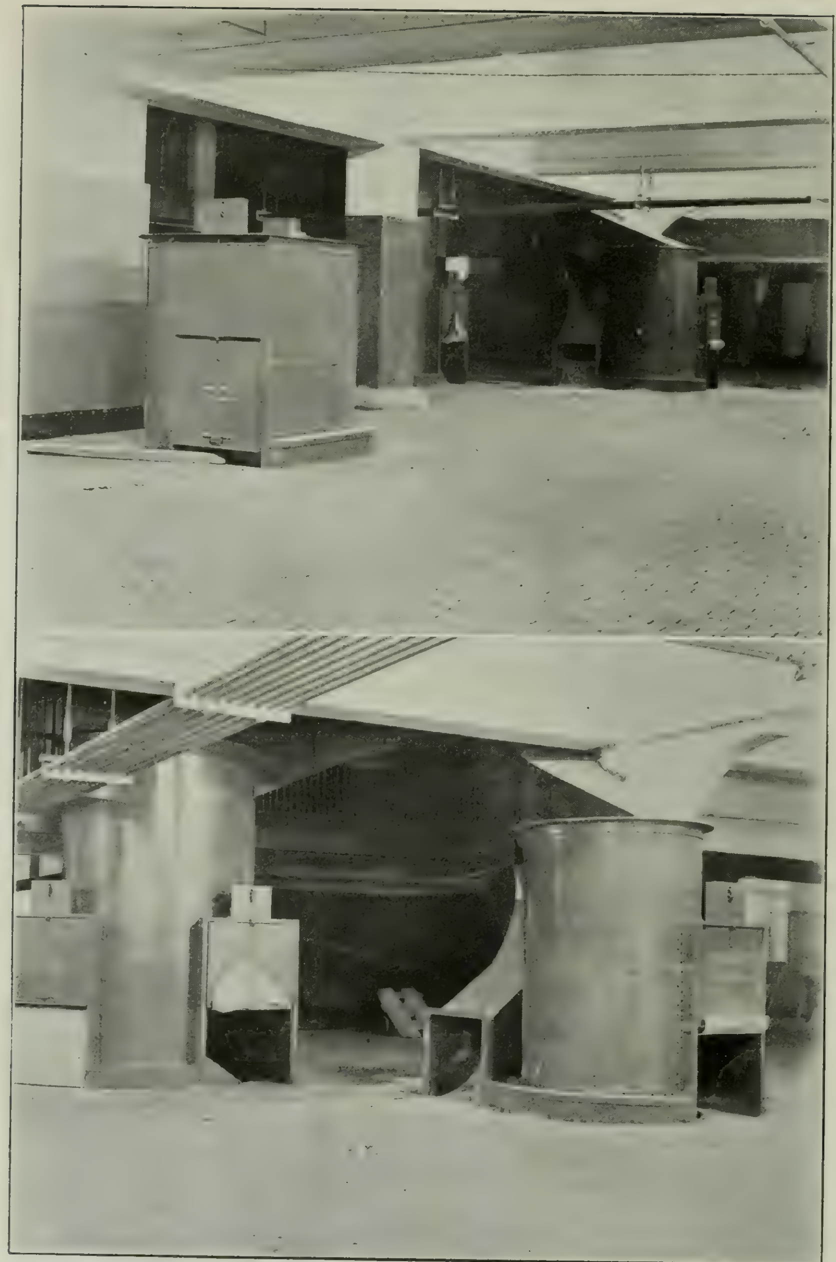
MACHINERY FOR OUTGOING MAIL.

STRUCTURAL FEATURES.—In the post-office building, the supports for all overhead belt conveyers, driving motors, etc., are hung on the overhead framing of the building. There are two sheds for housing the belt-conveyers as they extend west of the building. These sheds are supported on single lines of eccentrically loaded columns, using the cantilever construction to permit the longitudinal travel of belt trippers or unloading devices.

SPIRAL CHUTES.—In the design of the spiral chutes certain complications had to be met, due to space limitations and to the relations of the working areas in the post-office (for the receipt and handling



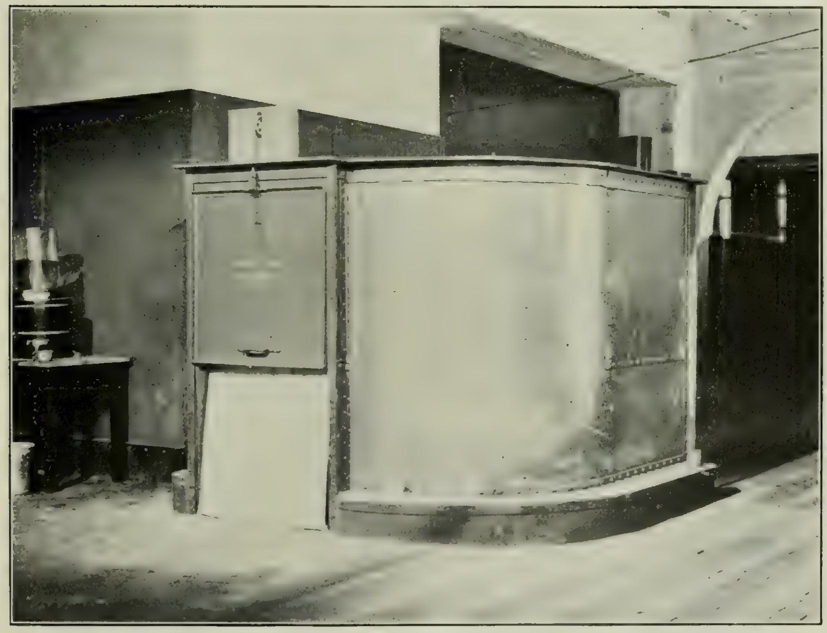
THE TRIPLE SPIRAL CHUTE.
The upper view shows the entrance, at north end of mailing floor. The lower shows the delivery table in basement, and inlet to east belt, platform 4.



BASEMENT CHUTES (AT LEFT OF THE UPPER VIEW) TO EAST AND WEST BELTS ON SOUTH ISLAND PLATFORM. AT THE RIGHT, THE QUADRUPLE CHUTE.

The lower picture gives a nearer view of the quadruple chute, showing three inlets and one delivery.

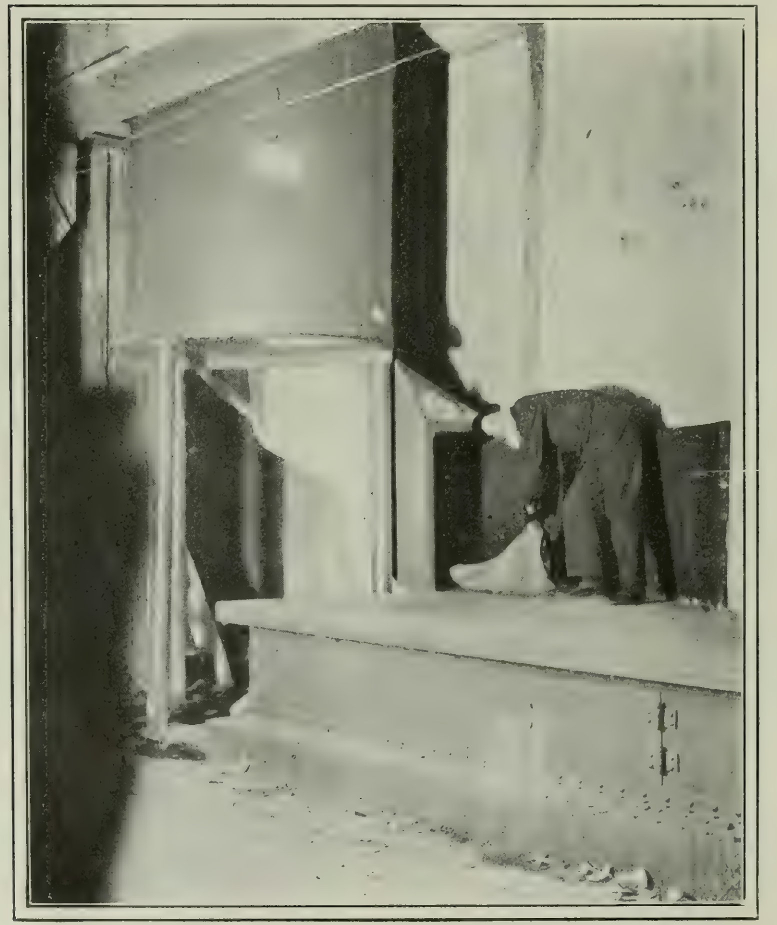
of the mails) to the platforms assigned to the railway-mail service. It was impracticable to make the spiral chutes vertical for the entire length, and it was therefore necessary to make numerous offsets of straight and curved slides. The vertical length of the chutes was also restricted by lack of head room and by structural conditions, and the inlet and delivery points of the chutes were fixed not only in height, but in arrangement and precise location. Space limitations also necessitated the grouping of the spiral compartments into double and triple chutes, and the arrangement of a single chute compartment for simultaneous operation at two different levels without interference. Moreover, it was impossible to make a symmetrical arrangement of the entrances to the triple and quadruple chutes, all four entrances of the quadruple chutes being placed on two sides and all three entrances of the triple chutes being placed on one side of the chute housing.



ENTRANCE TO CHUTE IN BASEMENT, SHOWING COUNTERBALANCED DOOR AND CANVAS WIND-CURTAIN.

The fixed conditions made it necessary to vary the pitch of the spiral slides at different points in the same chute, and to depend in some cases for positive action upon acquired momentum of the mail pouches, developed in points of the chute in which it was possible to use a more favorable pitch. In other cases the latitude in design was so small that the critical angle at which a mail bag will slide on a polished metal plate is exceeded by only two or three degrees. It was also necessary in some instances to resort to reverse curves and to change of direction of motion of the bag by baffle plates. The problem was further complicated by the wide variation of loads, ranging from that of the small and practically empty canvas mail pouch to a full bag of periodicals weighing as much as 300 pounds. The spiral curves are so designed that the speed and certainty of delivery of bags of the two extremes in weight and size is regulated or controlled by centrifugal action. It has been found by trial that a single letter and a 300-pound bag are delivered through the chutes in approximately the same time.

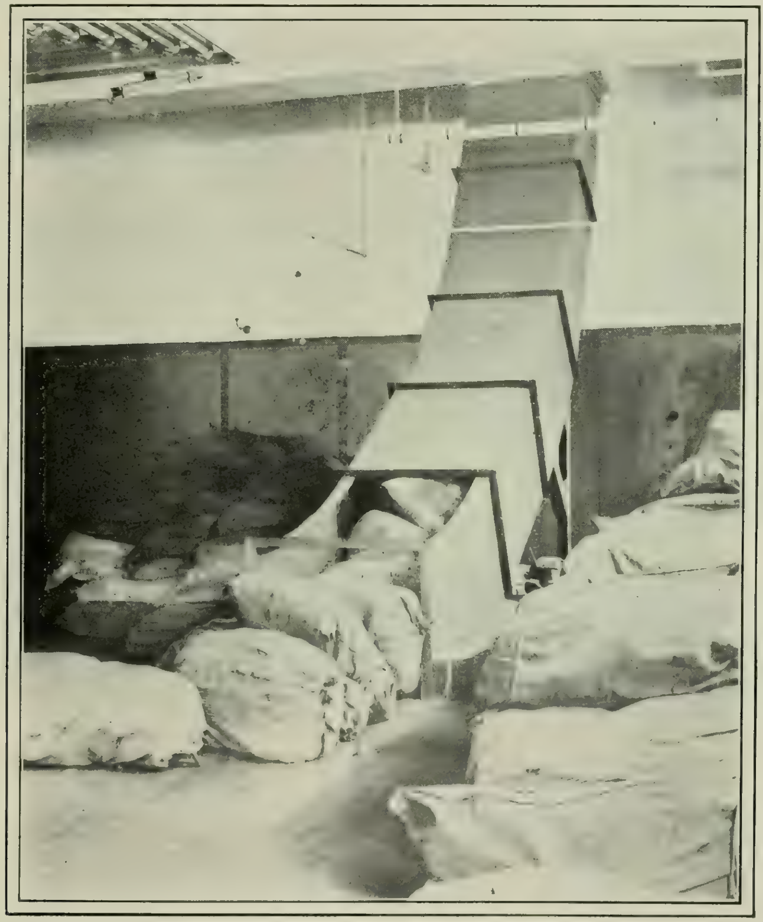
In addition to the spiral chutes a number of other direct chutes



DELIVERY TABLE AND SINGLE SPIRAL CHUTE IN TUNNEL B.

are installed, and these are constructed with curves of parabolic form, securing a maximum speed of descent but delivering the bags at the bottom at a minimum velocity.

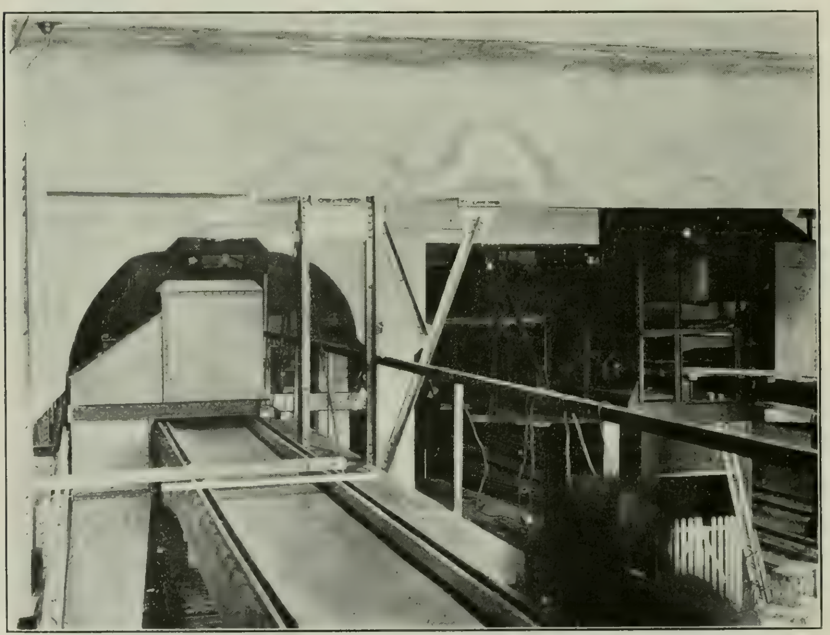
Belt-Conveyers.—The space limitations necessitated an entirely new design of conveyor-belt tripper, or unloader, for delivering the bags directly in at the door of the mail cars, through an adjustable spout. The tripper is equipped with self-propelling gearing, clutches, and control levers and pedals, including a rail-clamping or locking device to insure stability during the operation of the tripper. It travels on three rails, and is mounted on trucks with a three-point suspension to compensate for inequalities in track alignment. Two of the platforms are curved, necessitating the installation of two conveyor



NEWSPAPER MAIL SLIDE IN OPERATION.

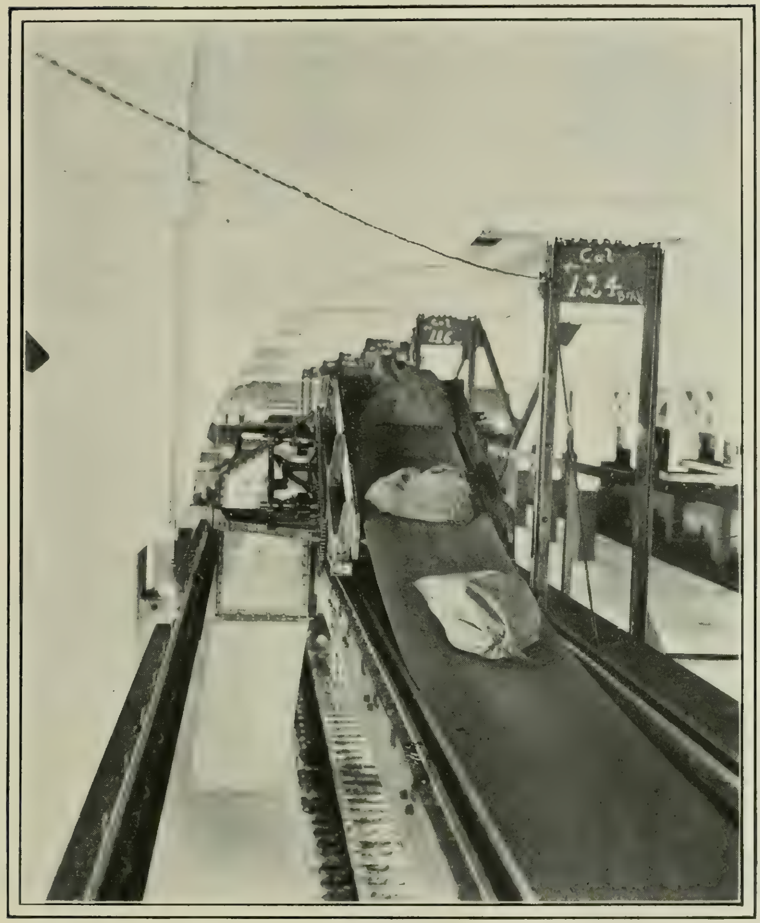
belts in series, with a special transferring device which was developed as an adjunct to two of the trippers.

To obviate the dripping of oil from the bearings of the overhead belt-conveyer rollers, it was necessary to use ball-bearings packed with grease and fitted with grease retainers. The application of ball bearings to conveyer rollers is not new, but it is believed that this installation presents the first application of the radial type designed with provision for expansion and contraction of steel shafts. The rollers and ball bearings are readily demountable, interchangeable, and adjustable, to secure the alignment of the belts. The rollers are constructed of light steel tubing. The material of the belts is the highest grade of five-ply heavy canvas of long-fiber Sea-Island cotton, impregnated with rubber and covered with rubber on both sides. The belts are made with half-round moulded edges, and contain almost half a mile of this rubber belting.



OVERHEAD BELT CONVEYOR AND BOTTOM OF ONE SPIRAL CHUTE.

Motors and Controllers.—The motors are direct-current 650-volt machines and are connected with feeders from two different sources of current supply, viz., the third-rail system of the Terminal, and directly from the main bus bars of the local sub-station. The motors and controllers are designed for both armature and field control, in order to secure a wide range in speed variation. Drum-type



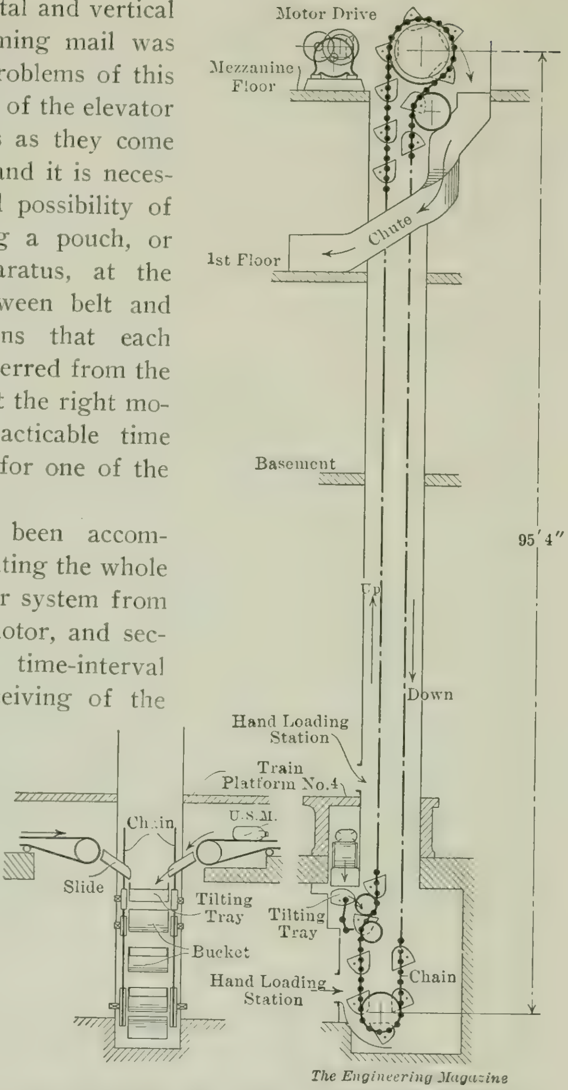
CONVEYOR BELT AND MOVABLE TRIPPER.

controllers are used, fitted with automatic overload and no-voltage release, push buttons being located at several stations along the gangways of the overhead belt conveyers to enable the motor to be stopped conveniently by the operator. The motor drive is a combination of silent-chain and spur-gear drive.

Machinery for Handling Incoming Mail.

Belts.—The conveyer belts installed under the platform are similar in constructional details to the overhead belt conveyers.

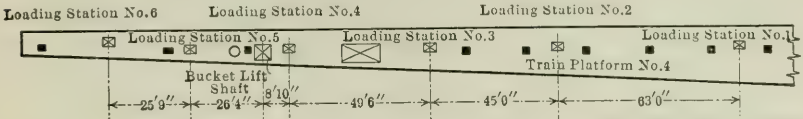
"Loading stations," are provided at frequent intervals, having hopper openings in the floor into which the arriving pouches are thrown, to be received on the moving belt. The belts must operate in conjunction with the bucket elevator, and the design of this co-ordinated horizontal and vertical equipment for incoming mail was one of the special problems of this system. The buckets of the elevator pick up the pouches as they come to it from the belt, and it is necessary to eliminate all possibility of crushing or injuring a pouch, or deranging the apparatus, at the transfer point between belt and elevator. This means that each pouch must be transferred from the belt to the elevator at the right moment (within a practicable time margin both ways) for one of the buckets to receive it.



The Engineering Magazine

SIDE ELEVATION AND PLAN. CO-ORDINATED BELT CONVEYOR AND MECHANISM FOR HANDLING INCOMING MAIL.

This object has been accomplished, first by operating the whole conveyor and elevator system from a common electric motor, and second, by applying a time-interval operation to the receiving of the pouches on the belt itself. When a pouch is thrown into the opening of a loading station it lands not on the belt directly but on a shelf above the belt. The pouch is pushed off this intermediate receptacle automatically, at the right moment, and falls on to the belt. The time of this deposit on the carrier is controlled by the movement of the distant bucket elevator, through the medium of compressed air in piping connecting with differential piston mechanism operating back and forth; the rising buckets, as they approach the delivery point of the belt, by operating a compressed-air valve included in this piping, cause the pouch to drop on to the belt at a determined instant. An interlocking mechanism prevents conflict of delivery of pouches from the two parts of the conveyer: When one belt is in operation the other is out of operation.



The Engineering Magazine

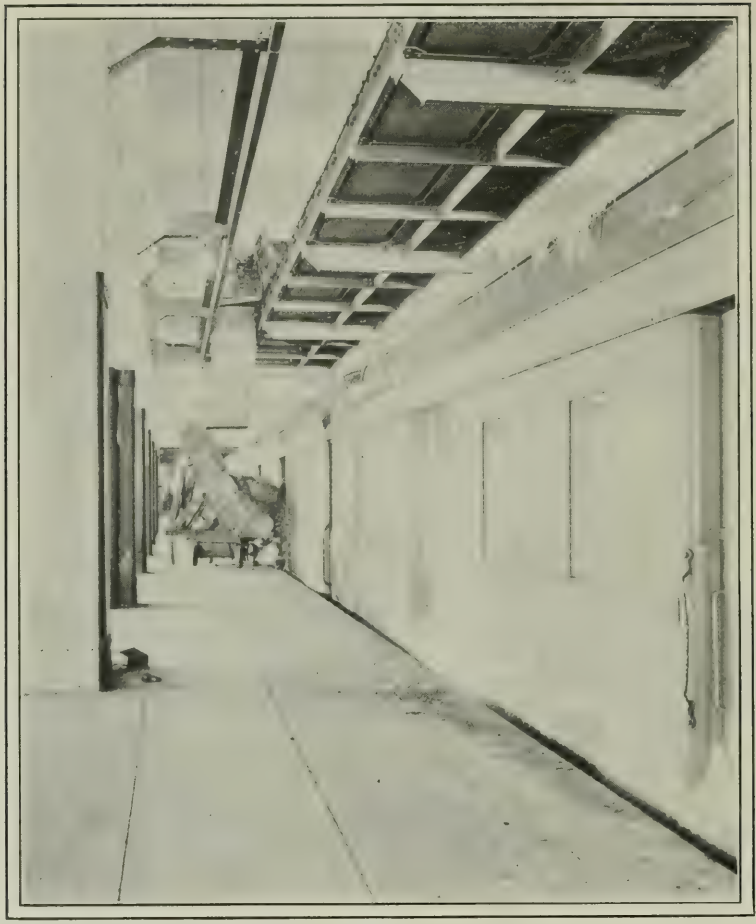
LAYOUT OF APPARATUS FOR HANDLING INCOMING MAIL, PLATFORM 4.

Bucket Lift.—The bucket lift is of special design in almost every particular. Some idea of its size may be gained from the fact that the buckets and the endless driving chains, together with the driving mechanism, weigh more than 20 tons, the highest grade of steel being employed in its construction. This elevator will handle 1,200 mail pouches an hour.

The driving chains are of short pitch, reducing the angular variations in velocity which obtain in the operation of the more conventional forms of bucket-lift driving chains, and securing a uniformity of motion approaching that of a belt drive. This end is also furthered by the design of special sprockets with double-staggered teeth. The chains have muitlple drop-forged nickel-steel links with solid bronze bushings, giving unusually large bearing surfaces on hollow pins of large diameter constructed of nickel steel, equipped with an internal system of lubrication, and so designed that lubrication may be regulated and maintained during continuous operation. The buckets are of pressed steel—thin, high-grade steel being used to reduce weight—and are fitted with re-enforcing end castings of steel, to which the chain pins are firmly secured. The buckets are so shaped that the bottom surface forms a slide of proper curvature to insure the positive delivery of the bags at the top of the lift.

Restrictions of space at the foot of the bucket lift necessitated the placing of the entire driving mechanism and slack-chain take-up at the top of the lift, in the mezzanine story of the post-office building. To reduce vibration and to secure proper alignment of parts, the entire overhead structure, motor and driving mechanism is supported on a massive base casting weighing several tons and filled with concrete, the whole resting on a sound-deadening pad of block cork.

To provide for the elevation and adjustment of the main bucket-lift shaft and driving sprockets necessitated a special design of driving mechanism, employing a propeller shaft with bevel gears mounted on



OVERHEAD CONVEYOR BELT IN OPERATION, WITH DELIVERY SLIDE SET AT A MAIL-CAR DOOR.

a radial yoke to secure permanent alignment between the stationary and the adjustable shafts, somewhat similar to the rear-axle propeller-shaft drive of an automobile. The bearings of the head shaft slide in curve guides, and are raised or lowered in parallelism by jack screws geared together for joint operation. The motor drive of the bucket lift includes a combination of spur and bevel gears, reducing the speed of the 650-volt, 50 horse-power motor from 150 to 4 revolutions per minute for the head shaft and main driving sprockets. The lubrication of shafts of low speed is secured by compression grease cups, and of shafts and bearings of higher speed by a complete system of forced-feed lubrication piped separately to each bearing.

MODERN MACHINE SHOPS AND INDUSTRIAL PLANTS.

By Charles Day.

This article concludes Mr. Day's unique and authoritative analytical treatment of the planning and building of industrial plants, which began in our issue of September, 1909. The entire series, enlarged, revised and adapted to book form, is just issuing from the press in a 300-page illustrated volume entitled "Industrial Plants; Their Arrangement and Construction.—The Editors.

THE plants of the Wagner Electric Manufacturing Company and the Orenstein-Arthur Koppel Company, previously described, are composed of a series of independent shops that adjoin and communicate with an erection shop. As has been previously stated, this type of layout has been adopted quite frequently for certain lines of work. The plant which we are now about to consider is of another well defined type, characterized by the condition that all the floor space needed is enclosed under a single roof. This procedure is made possible through the adoption of the saw-tooth roof, which eliminates the frequent necessity of providing areaways between separate buildings when roof lighting is not available. Of course the saw-tooth type of construction, when it is adopted in the manner that is now under consideration, necessitates the use of a ground floor only.

The plant of the Cincinnati Bickford Tool Company, shown in perspective in Figure 8, has been selected from a number of plants of the type in question as the combination of a number of different kinds of structures makes it a particularly good illustration of the manner in which definite industrial requirements were satisfied and future growth provided for.

The siding for the receipt and shipment of materials is shown in the foreground of Figure 1. The raw-materials and storage department is at present located in the rear of buildings "E" and "M-1," the front of the property being paralleled by the main line of the Baltimore and Ohio Railroad, which does not show in the illustration, Figure 8. Building "E" was designed primarily to accommodate the largest machine-tool equipment operated by this company and the erection of radial drill presses, but a section of it is used for the storage of heavy castings, so allowing for their transportation by means of the overhead traveling cranes installed in this building. The section of the saw-tooth building designated "M-1" is occupied by the machine department except for the space allotted to raw material. The section of this building indicated as "M-2" was designed primarily to accommodate the department for the erection of upright drill presses and the smallest size of radial drill presses, but certain machine tools are also located in this area.

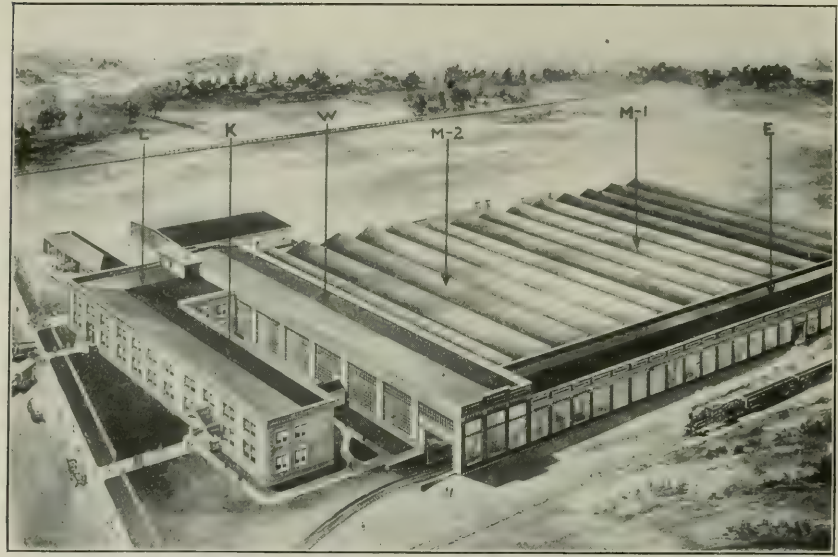


FIG. 8. PLANT OF THE CINCINNATI BICKFORD TOOL COMPANY, OAKLEY, OHIO.

Building "W" is used for the storage of finished product, an overhead traveling crane being provided for the handling of the upright and radial drill presses to the crating department located in this building, and finally for loading them on to the cars that enter the plant on the siding shown clearly in Figure 8. Department "M-2" is equipped with cranes operating in a direction perpendicular to building "W." so that the machines that are assembled in this department can be transferred to the warehouse with a minimum of handling. The construction of that part of the building that accommodates department "M-1"—namely, the machine shop—differs from section "M-2" only in that the headroom is 14 feet under the trusses whereas in the latter case it is 18 feet, the greater dimension being necessary in order to accommodate the erection work that has been referred to previously. Building "K" is a two-story office, and building "L" which adjoins the office and the warehouse accommo-

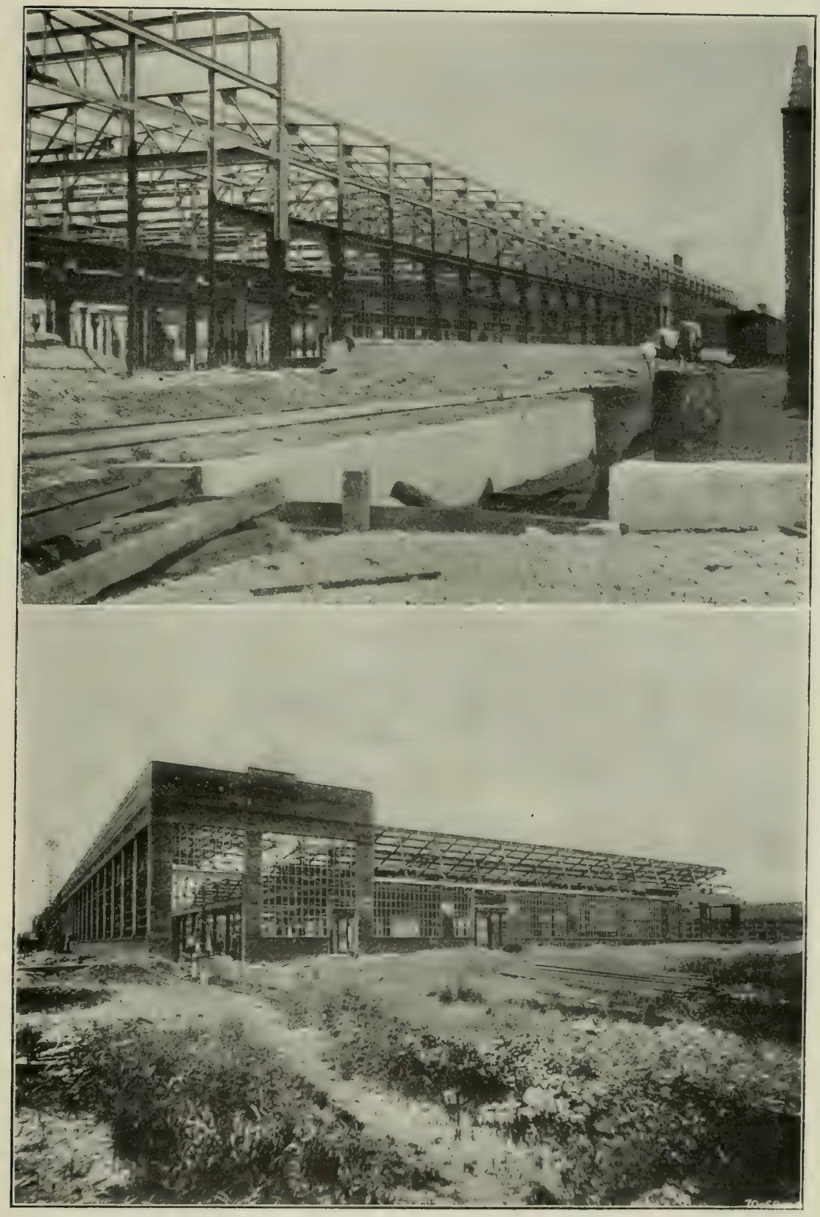


FIG. 9, 10. NEW PLANT OF THE CINCINNATI BICKFORD TOOL COMPANY, TAKEN DURING CONSTRUCTION.

The upper view shows in the foreground the steel frame for the erection and warehouse departments. The lower shows the erection and machine departments.

dates the pattern shop on the second floor and a service department for the employees on the first floor. The second floor of the office building, which is used by the drafting department, has direct communication with the pattern shop.

Figure 9 is a photograph of the plant during construction, showing the structural steel work of the end of building "W" and the side of building "E." Figure 10 is a photograph taken from the rear of the property looking into the saw-teeth of department "M-1" and showing the end of the erection department to the left. Figure 11 is an interior view of the machine and erecting departments.

The buildings shown to the left of the main plant (Figure 8) were constructed with a view to moving or taking them down when the time arrives for extending the plant in a direction perpendicular to the erection shop. The first extension, however, will be made in a direction perpendicular to the warehouse by adding to departments "E" and "M-1."

When the character of the work to be performed in a metal-working plant is such as to make it desirable to use single-story buildings the least amount of real estate is required if the type of layout is adopted that has just been exemplified. It is evident that the Cincinnati Bickford Tool Company will be able to utilize for shop purposes nearly all the property they have acquired if the growth of their business necessitates it.

Metal frames have been used throughout all the manufacturing buildings, both in the side walls and in the saw teeth. The plant is sprinkled throughout and the most approved appliances have been installed in connection with sanitation, etc A hot-water system of heating has been installed and the entire plant is driven electrically, the steam for the heating and the electric current for light and power being furnished by the central power station which serves the colony of machine-tool builders whose plants have been erected at Oakley, Ohio

In order to appreciate fully the advantages of the layout that has just been described, it is necessary to have not only a detail knowledge of the business in question but of the series of alternate arrangements or layouts for the new plant which were prepared prior to and resulted in the one herein illustrated The plant of the Cincinnati Milling Machine Company, adjoining the one just described, differs from it only in so far as the requirements of one business necessitate a somewhat different solution from the other.

A very large percentage of industrial plants handle a product that is characterized by its small bulk and the light weight of its

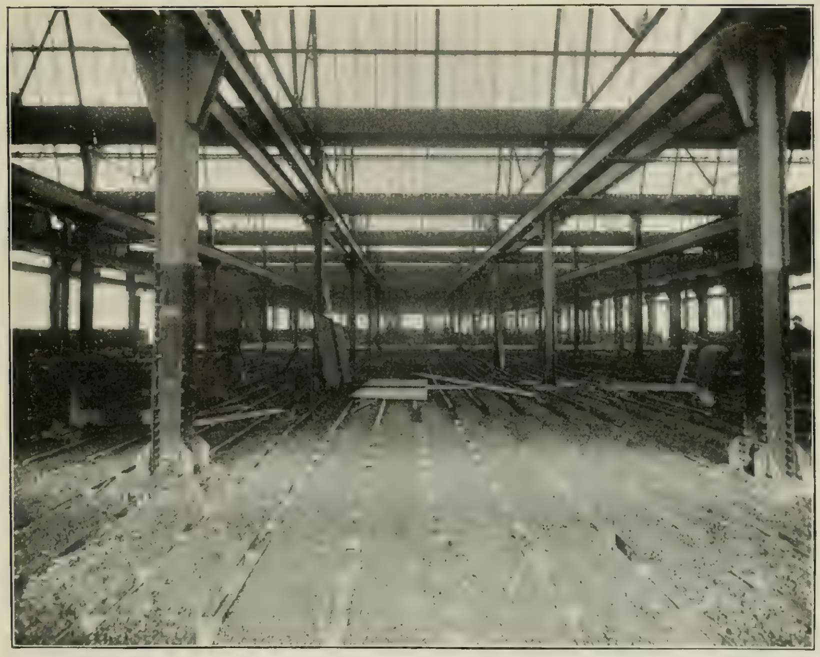


FIG. 11. INTERIOR OF CINCINNATI-BICKFORD MACHINE AND ERECTING DEPARTMENTS.

individual units. It was pointed out in a previous chapter that such requirements are, as a rule, satisfactorily cared for through housing the work in multiple-story buildings, which in one sense may be considered standard in their principal features, as they are suitable for many different businesses coming within the broad class in question. Therefore, insofar as the buildings proper are concerned, the question of layout is not a governing one, it being largely a matter of providing the requisite area. Of course the arrangement of departments and the grouping of equipment is a very vital matter to the business that occupies a building of this character, but for the moment we will not consider this phase of the subject. From this standpoint the principal matters of interest relate to features that make for the desirability of the building in question, irrespective of its occupancy. These are principally the ones of fire-prevention through non-combustible styles of construction, good natural lighting through the provision of a maximum window area, reduction of maintenance charges through the utilization of materials that will undergo the minimum depreciation, the provision of the most approved sanitary arrangements, and means for the prompt exit of all employees in the event of fire, explosion, or other catastrophes.

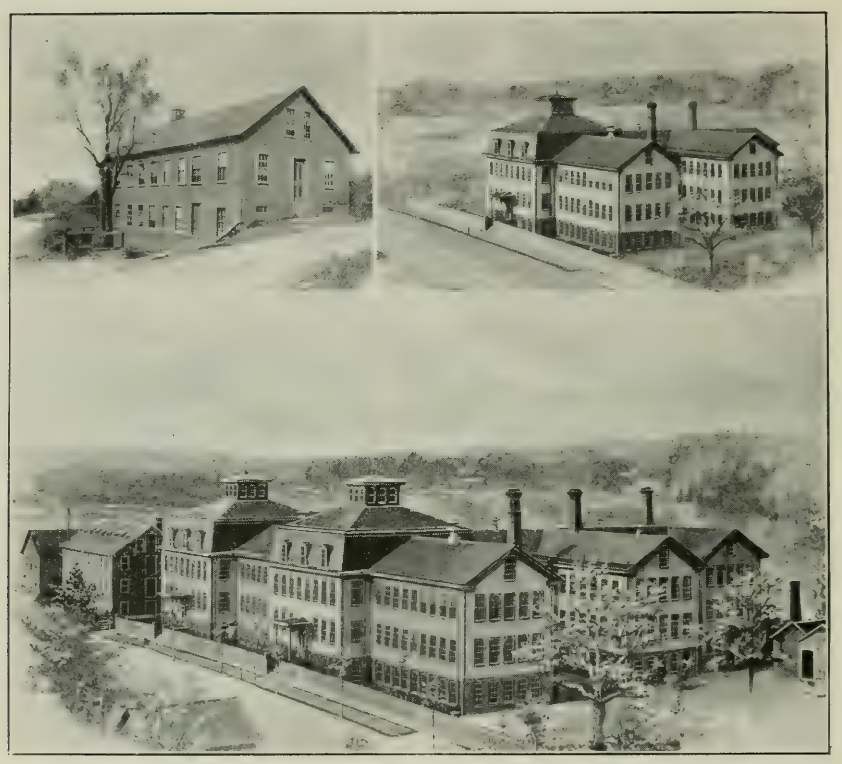


FIG. 12. STAGES IN THE EVOLUTION OF THE MANUFACTURING PLANT OF THE AMERICAN OPTICAL COMPANY, 1839-1872-1882.

These requirements have been satisfied with varying degrees of thoroughness by those who have recently constructed multiple-story manufacturing buildings, one of the best illustrations being the new plant just completed by the American Optical Company of Southbridge, Massachusetts, for the manufacture of spectacles and eyeglass lenses. This building incorporates all the features which the American Optical Company have found to be desirable from an economic standpoint after having given this subject their closest attention for many years. It represents the most recent attainment resulting from a gradual evolution that had its beginning in a small frame building constructed in 1839. Industrial manufacturing companies rarely consider the subject of their buildings with anything like the thoroughness that has always been the case in this instance, and as the procedure adopted at each important stage in the development was thoroughly tried out, the conclusions that have been reached are particularly significant. On this account I will recite briefly the principal considerations that brought about the gradual change in a policy, which in the first instance sanctioned frame structures and at the present time dictates the use of wholly fireproof buildings possessing the characteristics about to be described. The principal product of the American Optical Company comprises spectacle and eyeglass frames, lenses and cases of all kinds and types, and in addition certain other allied lines.

The status of the construction of industrial buildings in the year 1839, coupled with the resources of those who commemnced at that time the business that has since become the American Optical Company, left but one course of procedure insofar as the plant was concerned; namely, the erection of an inexpensive frame structure. The business grew gradually in the beginning and prior to 1872 extensions were made at the original site. It then became necessary to enlarge the plant still further, and in order to provide for the future a new location was purchased and the buildings constructed that are shown in Figure 12, dated 1872. These buildings were all of frame construction throughout, but superior in many respects to the earlier buildings. Between 1872 and 1882, the plant was extended until it had reached the proportions shown by the third picture in Figure 12.

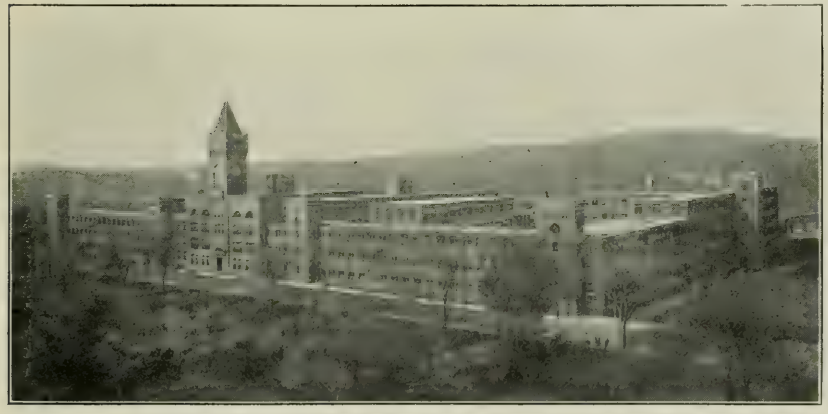


FIG. 13. SHOWING DEVELOPMENT OF MAIN PLANT, AMERICAN OPTICAL COMPANY, SOUTHBRIDGE, MASS.

Throughout the decade immediately prior to 1882 the business grew with very great rapidity, so that the value of the raw materials, finished parts, finished product, special machinery, and tools and fixtures housed in the plant, had reached a very considerable figure from the standpoint of invested capital alone; and when appraised as a factor in the perpetuation of the business, its value was, of course, much greater. A realization of this condition emphasized the necessity of making all reasonable provisions for the prevention or isolation of fires, and definite steps were immediately taken toward this end. One of these consisted in the removal of all of the hipped roofs with their slate coverings and their replacement by flat roofs with felt and slag coverings, so eliminating the hazardous attics which formerly existed.

These buildings were also modified in numerous respects in order to render them more adaptable to the requirements of the business which the company was constantly defining with greater accuracy. It was not, however, until 1899 that the first building with brick walls was constructed. The decision to adopt this type, known generally as mill construction, was based upon the resulting reduction in fire risk and maintenance expense and the fact that the problems introduced by greater floor loads than had formerly been imposed could be very satisfactorily solved. After one of the old frame buildings was torn down and was replaced by a larger one of mill construction and brick walls, the advantages ot the new structure were so apparent that it was decided to replace all the frame buildings as rapidly as possible. In this connection it is particularly interesting to note that it was not possible to keep abreast of the times through modifying from time to time the existing buildings, no matter how radical these modifications might be. The result could be accomplished only through destruction of the old and the building of entirely new structures.

Each building of the mill-construction type that was erected marked an advance in many particulars over those previously erected. For example, in the earlier types the heavy girders were built up by bolting together a number of timbers of the requisite depth but of such a width that in the aggregate they gave the required cross-section. The spaces between these timbers presented a very considerable fire risk, so that solid beams were substituted. The need of providing the best possible natural lighting, owing to the character of work performed, resulted in the adoption of larger windows in the side walls, accomplished through making the pilasters narrower and carrying the windows as close to the ceiling as was permitted through the use of a brick arch carried over the window head. The single flooring of the earlier types was soon replaced by double flooring, or superseded by it when new buildings were put up. Many of these early features of construction cannot be found in the present plant for reasons that have already been given.

As this work was progressing the plant was constantly approaching the appearance illustrated by Figure 13, this entire plant having

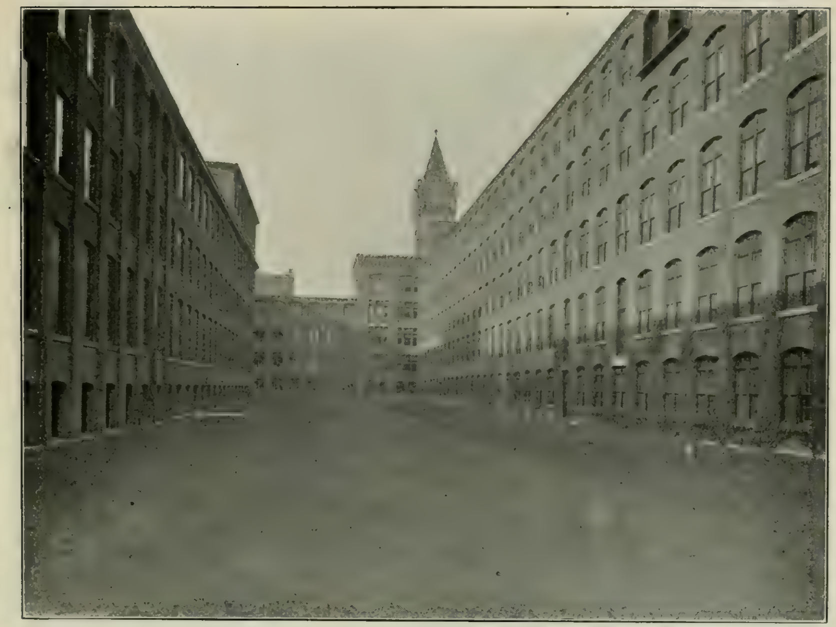


FIG. 14. VIEW BETWEEN THE BUILDINGS, SHOWING DIFFERENCE IN WINDOW CONSTRUCTION.

been constructed in eleven years, as has also a plant, located but a short distance from the main building, where all the lens work is done.

Before the plant illustrated by Figure 13 was completed the company adopted brick and steel construction in place of brick and timber. By so doing a greater window area was secured through making the pilasters narrower than before (this being made possible because the brick walls in this case are curtain walls and not bearing walls) and by carrying the windows up to within an inch of the ceilings, accomplished through the very ingenious adaptation of a Z-bar lintel, one leg of which carries the brick wall and the other the flooring, which consists in a 4-inch underplank, 1-inch lining, and maple wearing surface. These buildings incorporate the most approved practice in regard to fire towers and full equipment for the combatting of fires. Figures 15 and 16 illustrate the old and new types of window construction.

During 1900 it became necessary to make separate provision for the lens work, which had outgrown the accommodations available at the main plant and further required a special type of building for its efficient performance. The building that was constructed for this purpose is not included among the illustrations but is referred

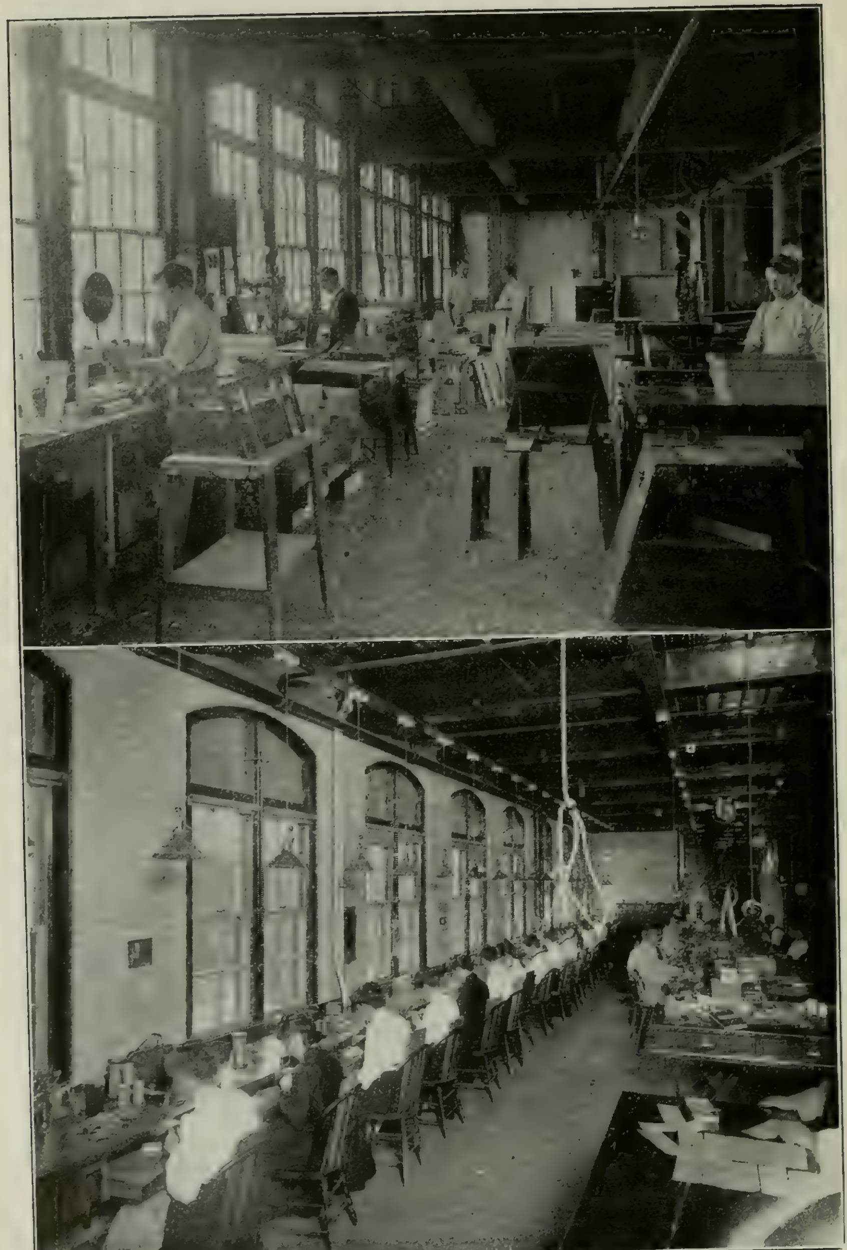


FIG. 15, 16. SHOWING NEW AND OLD TYPES OF WALL AND WINDOW CONSTRUCTION.

to as it marks a departure from the previous practice to the extent that a concrete floor was used.

The building most recently constructed (1910) is the one illustrated in Figure 17, being the new lens-finishing plant which was referred to previously as being one of the best illustrations of modern multiple-story building construction. Figure 18 is a near view of one of the side walls and shows the stair and elevator towers which also accommodate the toilets. Figure 19 is a photograph of the fourth floor before any painting was done, and shows the floor construction, the extent to which natural lighting has been secured through side windows, and the location of the hot-water pipes for heating. Figure 20 is a photograph of one of the departments that was taken before it was fully equipped and gives a good idea of the appearance of the interior after the painting is completed.

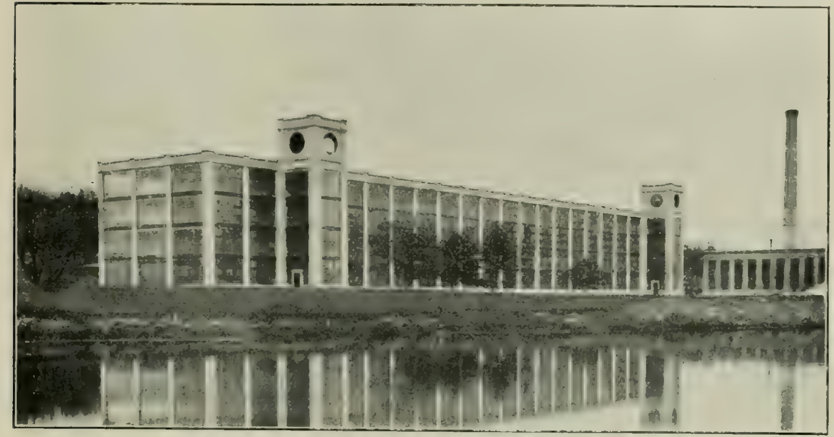


FIG. 17. NEW LENS FACTORY, SHOWING WINDOW CONSTRUCTION.

A tunnel 10 feet wide, 8 feet high and about 1,500 feet long extends from the power plant to the main plant, passing directly under the lens building just described. As the main plant is separated from this lens factory by a stream, the passageway gradually emerges from the ground and spans the stream, entering the main plant above grade. The principal object of this tunnel is to carry water and heating pipes and light and power wiring. It is constructed of reinforced concrete, the design having been very efficiently worked out.

The adoption of reinforced-concrete construction throughout, metal window frames, a sprinkler system, and the absence of any adjoining fire risk, have resulted in the attainment of a minimum fire

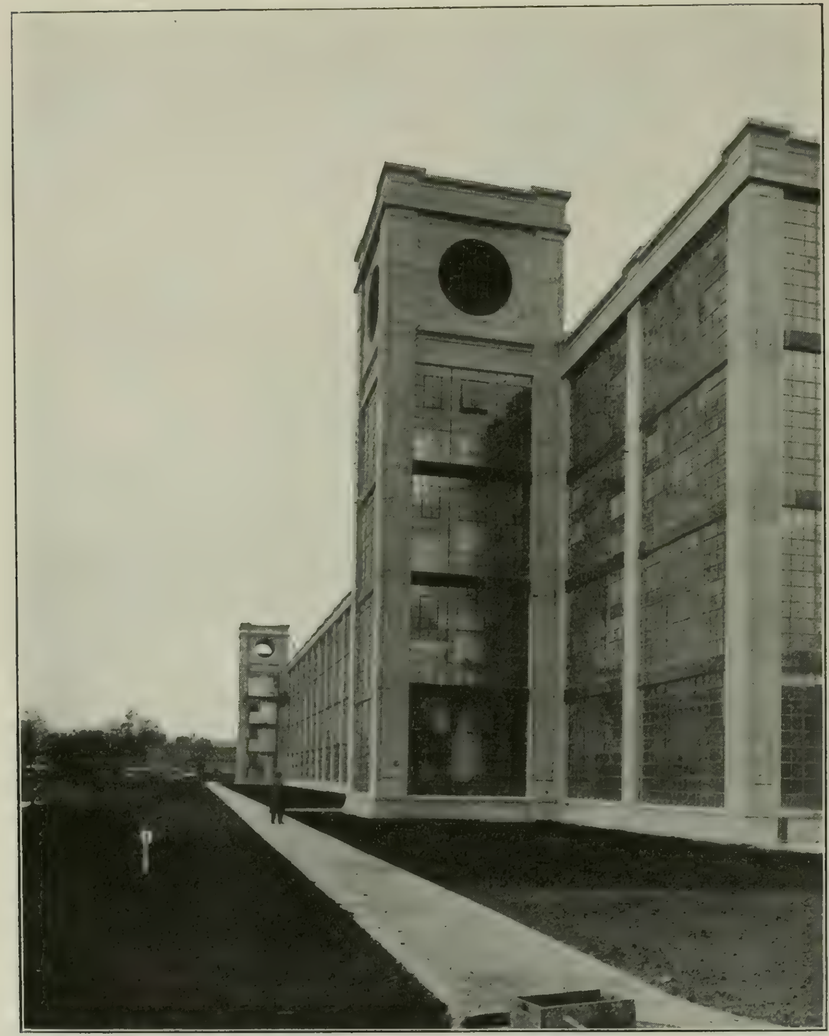


FIG. 18. NEW LENS FACTORY, SHOWING WALL AND WINDOW CONSTRUCTION.

hazard, and the fact that the windows extend from within a few inches above the floor (a condition consistent with the manufacture of a light product) up to within a few inches of the ceiling, and from pilaster to pilaster, assures the best conditions for natural lighting. The problem of heating has been simplified by double-glazing all the windows. The entire floor areas are available for offices, manufacturing departments, etc., no limitations being imposed through the presence of partitions, stairs, or other enclosures that would interfere with the most efficient disposition of the space. While utility was the motive that governed in the design of this building, yet I think it will be generally conceded that an exceedingly satisfactory

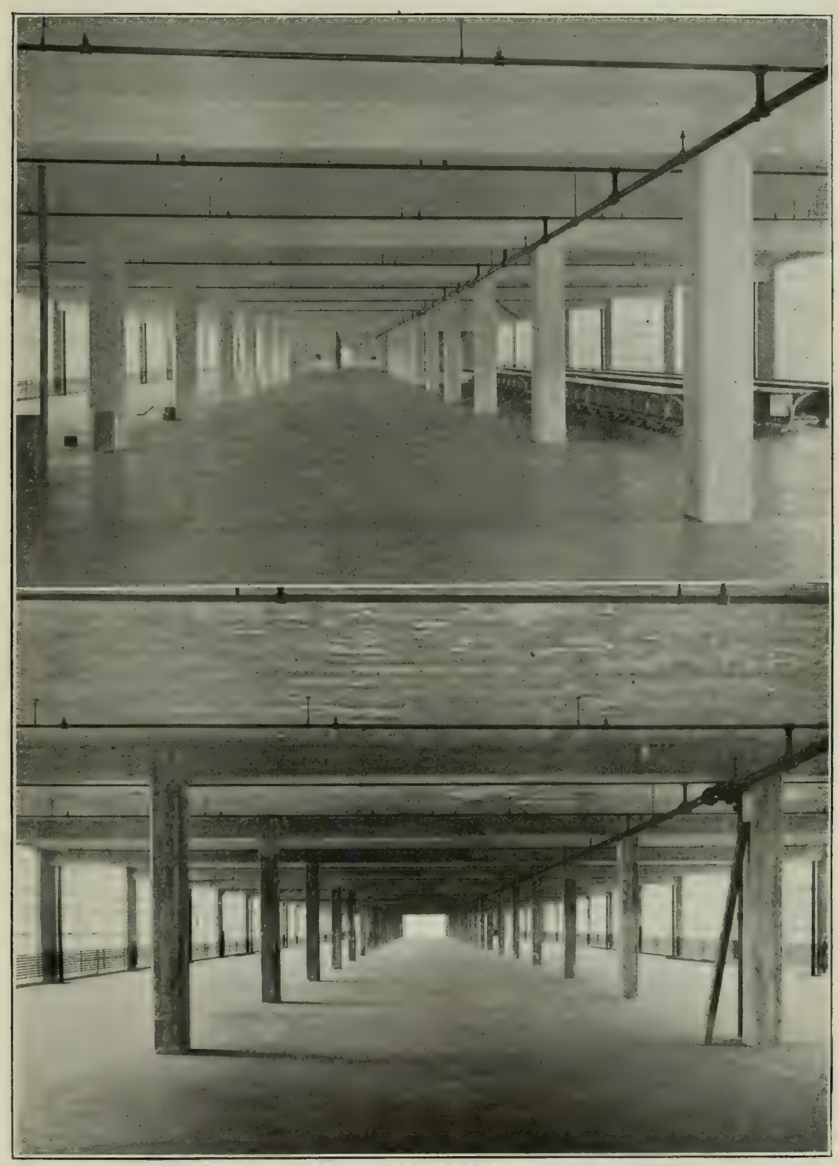


FIG. 19, 20. FOURTH FLOOR, BEFORE AND AFTER PAINTING.

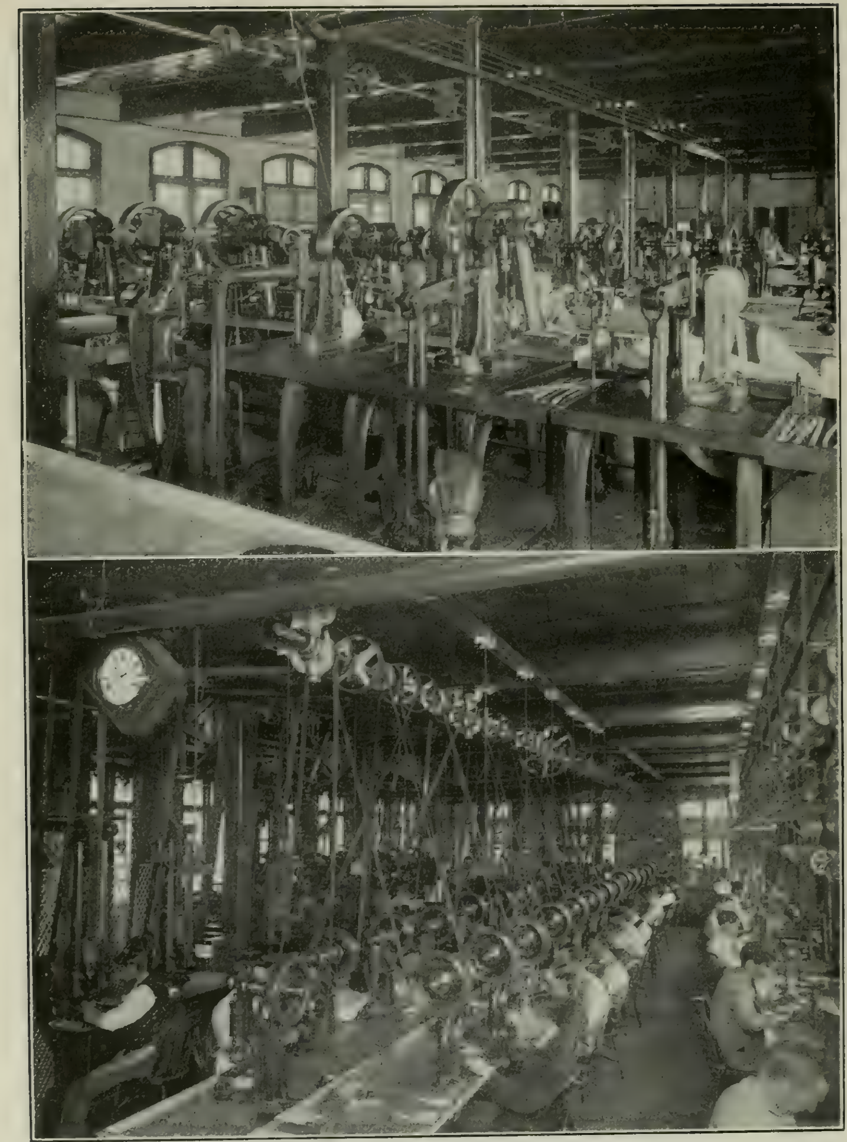


FIG. 21, 22. NEW AND OLD ARRANGEMENT OF PRESS ROOM, AMERICAN OPTICAL CO.

and pleasing appearance is presented by the exterior, the simplicity of the treatment being in thorough keeping with the uses for which the building is intended.

All the features that have been touched upon so far in connection with the plant of the American Optical Company are governed

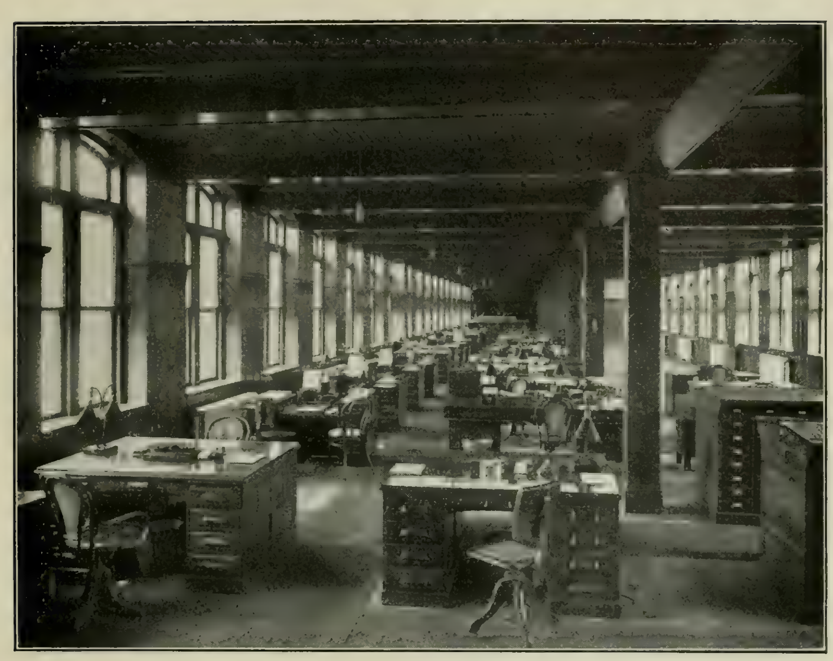


FIG. 23. INTERIOR VIEW OF ONE OF MAIN OFFICE DEPARTMENTS, AMERICAN OPTICAL COMPANY.

only along very broad lines, by the special requirements of this particular manufacturing work. If the methods that have been worked out by the American Optical Company for their own buildings are efficient for their purpose, they are equally suitable for many other lines of light manufacturing work. Each manufacturer, however, must make provision which is wholly special in many particulars for the actual work that he intends to do. However, even in this regard there are certain matters, such as the provision for artificial illumination, method of driving the equipment, the manner of laying out work benches, etc., which present the same essential requirement, irrespective of the industry. Figures 21 and 22 show the old and present methods of driving certain equipment in the plant of the American Optical Company, and also exemplify the practices of laying out benches during the respective periods. It is not necessary to dwell upon the desirability of eliminating overhead line and countershafts for at this time these are generally appreciated. The layout of benches illustrated in Figure 22 is, however, a departure that is comparatively new and possesses many decided economic advantages. Better natural lighting is secured, a greater number of operators can be properly accommodated within a given area, the product can be handed to and from the operators with greater facility, and by having all the operators face in one direction, a more strict attention to their work is automatically secured. Individual lights are provided for each operator. They are mounted upon suitable stands connected by a flexible cord and attachment to the circuit, which is in conduit and made fast to the backs of the benches. There are many other features in regard to the equipment of the plant that I would like to mention, but those just referred to serve as good illustrations as they are thoroughly characteristic. An interior view of one of the main office departments is shown in Figure 23.

While I have described very briefly the evolution that marks the gradual perfection of the buildings that from time to time have composed the plant of the American Optical Company, yet it must be apparent to the reader that this development could never have taken place were it not for the unceasing attention to all the problems involved and ability shown in their solution upon the part of the men at the head of this business. I feel especially indebted to them for making available the material that I have used, and wish to take this occasion to thank them for the co-operation that they accorded me.

SYSTEMATIC FOUNDRY OPERATION AND FOUNDRY COSTS.

By C. E. Knoeppel.

V. THE IMPORTANCE OF EFFICIENT DISPATCHING IN THE FOUNDRY.

In the article inaugurating this series, published in October last, Mr. Knoeppel outlined the elements of the foundry problem. His second paper discussed thoroughly the very important question of depreciation as its comprehension applies especially to the profitable conduct of a foundry business. In December he took up the remaining elements to be recognized in foundry organization and accounting and defined the character and limits of each. His fourth instalment dealt with the problems of production and the systematic treatment of the conditions that affect the actual productivity of the workman and the foundry. He proceeds now to the dispatching of the work, thus making a practical application of the efficiency principle discussed by Harrington Emerson in this same issue.—The Editors.

PARADOXICAL as it may seem, many apparently unimportant things are found in the end to be vastly important. Under the heading "delays" in the previous paper, it was found that the waste of five hours of the twenty-four spent on the job in question, was due to causes most of which could have been eliminated. No one would accuse the management of this shop of deliberately forcing the five hours of waste time on the moulder who made the work. If not the result of deliberation, the waste must have resulted from carelessness, faulty conditions, or other reasons. It seems certain it could not have been considered of the utmost importance or steps would have been taken which would have resulted in the wasted hours *not appearing in the list.*

What then was the trouble? It can no doubt be said for this particular shop management that it was probably doing the best it could to run things economically, according to the generally accepted conception of what constitutes the best one can do; it was probably holding its own with other foundries in turning out castings of good quality in point of material and workmanship; it was no doubt ambitious to get castings made as quickly as possible; it probably felt a "fall down" as keenly as you or I would feel it; it no doubt possessed as good a technical knowledge of the foundry business as would be found in other shops. Yet in spite of all this, the illustration cited shows very forcibly that something must have been decidedly wrong—something that would justify a careful analysis as to underlying causes, with an outline of a more efficient procedure—the purpose of this paper.

Did you ever see a bird in its search for twigs, straw and the like? Hunting these things for fun? Hardly. It is simply planning ahead against the time when a warm, comfortable nest will be wanted for the little ones to come. It does not wait until they have arrived—the bird sees to it that the nest is ready before it will be needed and as a result we call it a wise bird.

Watch a sprinter. He does not depend altogether upon his speed to carry him over the course. His whole aim is centered on the *start*—the dash at the crack of pistol. Even to the long-distance runner the start is of moment—he thinks ahead. Would he run his head off at the beginning? Not if he knew the racing game as an expert knows it. His start would consider conserving his energies for the contest before him. He would even let others pass him, secure in the belief that the finish would take care of itself if the start was one that did not make too many inroads upon his vitality before he got his "second wind."

These illustrations point out a lesson worthy of attention, for they show conclusively the importance of the prepared state—*the value of the start.* Results, whether in life or in business, depend largely upon this start, but *industrial endeavor has suffered much from failing to give proper attention to a definite plan of procedure.*

This, then, is a cause of the trouble that we started to find. If the work had been made to submit to a definite plan of procedure, the start would have received its share of attention—as much attention as the work itself, if not more. Not only is this general neglect of the start largely to blame for troubles, but the spirit of things is usually impulsive rather than methodical. "Get the thing done" is the order, and the procedure becomes one of a rush, hustle, tear-things-to-pieces kind, in a mad effort to obey orders, regardless of whether or not these orders could have been obeyed to better advantage some other way.

Suppose, for instance, that a corporation decided to build a railroad from one city to another, and that without a survey or general plan, it commenced to lay tracks—strike a stream—have a bridge built and set—then continue laying track—run into a hill—cut a tunnel—lay more track, and finally build a depot at the end of the line. What kind of a policy would this be called? Yet this is the way that many foundries are operated. A foundry should be managed just as a wise corporation would build its railroad, by having a definite plan and the bridge building and setting, the tunneling, the erecting of a terminal, and the grading and track laying *all going on at once.*

To test the question I would ask those in positions of authority to try the following: In the first place size up the situation generally as regards work under way, orders ahead, etc., and after the noon hour, call in the shop foreman, the core-room foreman, the flask boss, the flask carpenter, the man in charge of the pattern storage, the labor boss, and the pattern-shop foreman. In a general way tell them that the purpose of the meeting is to line up the procedure for the next day and perhaps the day following, and that each one will be expected to outline his share of the work. Be prepared to list the procedure as it is outlined. Have before you a list of the moulders and begin by asking the shop foreman what he proposes giving each of his men on the list, for next day. Also inquire what they will start on after the work just mentioned has been made. Ask the foreman for his ideas as to the time the jobs mentioned will probably take. If two jobs are not sufficient for the day, get him to assign enough work to cover the man's time fully.

Now get your core-room foreman to advise you what cores he has made or is going to make for the next day's work. Ascertain if the pattern-storage man can tell you what patterns he has laid out or is going to lay out for the work on the following day, and then quietly ask the labor boss what rigging in the way of flasks, plates, etc., he is planning to bring in for the work to be made in the next few days. See if the flask boss can tell you what he is doing towards getting flasks ready for the next day's work, and then ask the flask carpenter what flasks he is working on or what he expects to work on to accommodate the new work coming in. Find out what patterns the pattern-shop foreman is getting ready for the shop. Other questions will suggest themselves as you go along, which you can put to those interested.

After each one has had an opportunity to outline his share of the procedure, dismiss the meeting and study carefully what you have before you. Also arrange on the following day to check up the shop operations to see how closely the outline of the preceding day is being lived up to by each one interested. Note the waits, delays, changes in plans, etc. If the results prove surprising both in the meeting and the procedure on the day following; if you find the "all pull together" spirit conspicuous by its absence; that the actual carrying out of the work comes as close to schedule as a train in a winter blizzard; if you find that the meeting which started with broad grins ends in bewilderment and confusion and that there was considerable guess-work about the whole thing, *it is safe to conclude that the value of the result depends upon the efficiency of the start.*

A train leaves New York at eight o'clock in the morning and is due in Buffalo at five o'clock in the afternoon, stopping at Albany, Utica, Syracuse and Rochester. From the time previous to its leaving New York until it arrives in Buffalo, the train is carefully watched, its leaving time at each point being wired ahead, orders being issued at each stop for the next lap of the journey. Does the engineer or conductor worry about the arrival in Buffalo? Hardly. Their chief concern is the trip from New York to Albany; Albany to Utica; Utica to Syracuse, to Rochester, to Buffalo. If engines are to be changed at Albany, the engine is ready when the train pulls in. If a slower train is ahead of the fast one, at a certain place, *known in advance*, it is side-tracked to allow the fast one to pass. In case a dining car is to be attached at Utica, it is a safe bet that the diner will be added to the train as soon as the stop is made. If the crew is supposed to change at Rochester, it will be found that the new crew is on hand and waiting for the train—something would happen if they were not. The train arrives in Buffalo on schedule time, according to a plan mapped out in New York before the train left, and lived up to all along the line—a smooth, harmonious working arrangement, known in railroad circles as "dispatching"—the theory of which is, *no train is ready until everything is or will be ready for the train.* Why not therefore apply the same theory to the foundry business and dispatch jobs in the same manner as a railroad dispatches its trains?

In order to get all that is possible out of the foundry, we must get away from the theory that making a piece of work depends altogether upon the moulder, for the moulder in the broadest sense *is only a medium*—the factor between (A), what he is given to work with, (B), the conditions under which he works, and the finished casting, from which we can readily understand why A and B should receive careful consideration in their relation to proper dispatching of work—more attention than is usually given them.

As to A—the articles a moulder is given to work with—they can be classified as follows:

1—Those subject to changes (equipment and rigging)
    Patterns
    Sweeps
    Flasks
    Loam plates
    Lifting plates or rings
    Spindles
    Arbors
    Cores

- 2--Those subject to little or no change.
  - A—Facilities
    - Sand
      - Facing
      - Heap
      - Parting
    - Risers
    - Nails
    - Gaggers
    - Rods
    - Chaplets
    - Blacking or wash
    - Clamps
    - Wedges
    - Chains and rolling devices
  - B—Tools
    - Rammers
    - Hammers
    - Shovels
    - Finishing tools
    - Torches and wicking
    - Hooks
    - Wood screws
    - Brushes and swabs

Concerning B—the conditions under which a moulder works—it is obvious that he can work efficiently only when he can use, to the best advantage, the items listed at A, so *it is distinctly up to the shop management* to see to it that the men are not held up because of faulty conditions. They must be made right. As an example of what I mean:—a moulder (now a shop foreman) had been hired, and, coming from another city, he started in the next morning. He was given a piece of work to make, and from 11 to 12 o'clock he was hunting up gaggers for his mould; not finding any, he looked up his foreman and advised him as to his fruitless search. The foreman asked the moulder if he thought he had any tucked away in one of his vest pockets, to which the moulder replied —"no and I didn't bring any in my grip either." After the noon hour, the moulder quit and the foreman was at a loss to understand why. The moulder was quick to see that he would be working at a disadvantage if the foreman evinced no greater concern than his remark indicated, and the foreman violated two of Mr. Emerson's twelve principles of efficiency—common sense and the fair deal—first in making the speech he did, and second in not seeing to it that the gaggers were quickly found and promptly supplied the moulder.

These conditions we may classify in a general way as follows:

1—Foundry orders—knowledge of and their following up.

2—Storage and handling of materials, supplies, etc.

3—Selection of patterns, sweeps and core boxes.

4—Repairing and altering the above.

5—Selection of flasks.
6—Repairing and altering the above.
7—Flask storage, piling, etc.
8—Removal of castings, gaggers, rods, etc., from the sand.
9—Tempering of moulding sand for use by moulders.
10—Mixing of facing sand.
11—Shop carrying arrangements with reference to the equipment and rigging listed at A1.
12—Supplying the moulders with facilities listed at A2A.
13—Furnishing the moulder with proper tools by list A2B.
14—Crane facilities.
15—Arrangements as regards the general shop labor.

Foundry dispatching is made up of three principal elements—

1—The parties concerned.
2—The planning.
3—Execution according to the plans

and if proper attention is given to them, faulty conditions will cease to exist, for their assumption is—*no job is ready until everything is OR WILL BE ready for the job.* The persons concerned are—

1—The foundry foreman
2—His assistant
3—The core-room foreman
4—The pattern-shop foreman
5—The man in charge of the pattern storage.
6—The man in charge of the flasks
7—The flask carpenter
8—The labor boss.

The element planning is made up of six principal considerations—

1—*What* is to be made } Selection
2—*Who* it is to be made by }
3—*Where* it is to be made —Location
4—*When* it is to be made —Commencement
5—*How* it is to be made } Procedure
6—*With what* it is to be made }

while *execution* is made up of—

1—Knowledge of the plans made
2—Preparations for carrying them out
3—Carrying out the plans as per schedule.

Now that the articles used have been classified, the general shop conditions outlined, and dispatching defined as regards elements and considerations, the task of next importance is to harness the three together so as to make an efficient working arrangement. To this end we must give some consideration to that which is really our starting point—*the order* both as regards its *availability* and *the promise to ship*. Right here is where nearly every foundry experiences trouble—some occasionally, others nearly all the time—because not enough attention is given to the availability of the work and promises are made before all the facts are known.

What must be considered in order to pass upon the availability of a piece of work? An order must pass the following test:—

1—Are the patterns and core boxes as per order?

2—Are they ready for delivery into the foundry?

3—Is there a flask or flasks to accommodate the work?

4—If not will one have to be made, or can other flasks be altered to suit, and if so, what work will be necessary?

5—What will the job take in the way of rigging?

6—Is the rigging on hand ready for use or will it have to be made? If it will have to be made what will be necessary?

7—Will anything be necessary in the way of specials, as for instance rods, gaggers, clamps, etc.?

8—How long will it take to get the job prepared as above?

Until an order can pass this test, it should be classified as *not available* and everyone so advised and under *no consideration except that of the most extreme urgency should such a job be started.* A rule of this kind will work wonders in any foundry.

After the matter of availability has been passed upon, the next thing to consider is—the promise—a point about which a book could be written. A few years ago in this magazine, the author made the following statement, in a paper on—"Better Deliveries—More Satisfied Customers"—

> A promise composed of about one-quarter discretion in making and about three-quarters energy in fulfilling will go a longer way towards enabling the manufacturer to ship according to schedule, than anything else. By energy I do not mean the hustle and bustle, at the last minute, in an almost superhuman attempt to rush the work through the shop and onto the cars, in an effort to make good, but an energy that is in evidence from the time an order is received and the promise made, until the material is on the cars and finally at its destination.

Orders are either accompanied by a request to make shipment at a certain time or are marked "rush," "as soon as possible," "at once," or perhaps the making of the work is left altogether to the shop management. Promises are usually required in all instances, and if not they should be made and recorded just the same as if they were required so that there will be some information on hand should the shop be asked a little later to furnish some idea as regards shipment. After promises have been made, it is not a difficult task to keep such track of them as will result in an excellent knowledge of anticipated delivery dates. One thing should be remembered, however—*promises should never be made before the availability of the work has been passed upon.* Such promises are never dependable and the time and energy in making them is usually wasted—as a great many know.

An efficient order arrangement that will give proper consideration to the two features (availability and the promise) must therefore be so arranged as

1—To admit of a quick and ready reference as regards the various items called for.

2—To show availability or non-availability, *at a glance.*

3—To show anticipated delivery dates.

4—To notify the pattern storage what is wanted in the way of patterns, sweeps and core boxes.

5—To enable pattern storage to promptly notify foundry as to the condition of the items called for.

6—To have the patterns, sweeps and core boxes laid out by the pattern storage in a space necessary to allow those who are responsible for the planning to get at them easily.

7—To show the reasons why the work is not available.

8—To have a provision for checking the work as the following items become ready—

A—patterns and core boxes; B—flasks; C—rigging.

It is evident from the above that we are now in possession of three valuable items of information—

1—We know what is *not* available and *why*

2—We know when work becomes available

3—We know when work is wanted or the promise date,

this knowledge serving as a valuable aid in keeping after the jobs not available and selecting what should be made—a condition of affairs much to be desired, as everyone conducting foundries can well appreciate. If every foundryman was in possession of the above information, what a saving there would be in time that is now wasted because the patterns are not ready, or cores are not made, or flasks are not in shape, or rigging is not in, and many other causes which result in loss of time that nets the company absolutely no return for the amount invested.

With our knowledge of what is available and what is to take preference, we can commence the task of getting the work under way according to the following general outline—

1—The work should be in charge of a committee comprising the foundry foreman, his assistant, the core-room foreman, the flask and labor bosses.

2—The work should be undertaken as early in the day as possible so as to allow ample time to get in readiness whatever may be needed to start the jobs off properly.

3—The work being made in the shop and the men engaged on it should be carefully sized up.

4—A means should be provided for listing the work as planned.

5—In selecting the work, the six considerations under the element *planning* should be brought into play.

6—If more than one job is selected for a man, attention should be given to the order in which they are to be made, as in this way it will be known what work to get ready first.

7—The core-room foreman should note carefully the selections so he may have the most important core boxes sent in first.

8—The flask boss should note what flasks will be necessary for the various jobs that are planned.

9—The labor boss should note what rigging will be necessary so that he can get at work as soon as the planning is over with.

10—A means should be provided for marking the patterns, with the names of the men who are to make them.

11—The pattern-storage man should set apart from the patterns available such as have been scheduled for making.

With the above consideration given to the planning, we can next consider the third element of dispatching—*execution*. As was previously pointed out, this is made up of three steps—knowledge of the plans made, the preparation for carrying them out, and carrying out the plans as per schedule.

KNOWLEDGE OF THE PLANS MADE—Any plan for betterment, in order to be productive of results, must take into consideration the importance of a general understanding of things. Several persons may be involved, and unless the relation of each to the whole scheme of things is clearly outlined, there is certainly going to be confusion, the same as there would be confusion on a railroad (or even worse, a serious wreck) if there existed any doubt as to a correct understanding of the orders that may have been issued. With this in mind, the idea of presenting the plans made to those interested, in some convenient form for reference purposes, is therefore self-suggestive. This should be done as soon after the work of planning as possible, in order to give those concerned the schedule of work so that they will have plenty of time in which to give proper consideration to the next step—

Preparations for Carrying Out the Plans—An analysis of this will show that it divides into the following—

1—The patterns

2—The cores to be made

3—The flasks to be located, repaired, or changed

4—The rigging to be brought in and the necessary changes made.

5—Special features looked into; for instance, special gaggers, rods, clamps.

6—Changes in conditions to facilitate the particular work coming in.

7—The work at night.

Patterns—Small patterns should be brought into the foundry on the afternoon previous to making and placed in racks for the men. Large patterns should be brought in toward night and be arranged in some convenient place from which point they can be easily handled.

Cores—As soon as possible after the planning, the core-room foreman should see to it that the most important core boxes are sent in so that his force can begin on them without delay. As soon as he gets his schedule showing the planning in detail, he can have the rest of the boxes brought in and the cores made in the order in which they are scheduled to be used.

Flasks—The man in charge of the flasks should ascertain what is necessary to take care of the work coming in. Flask parts that may have been previously made should be assembled; those needing chucking or changes in the barring should be promptly attended to, the necessary patterns to be taken from the pattern storage for this purpose. If repairs are needed they should be made at once.

Rigging—Rigging in the way of plates, rings, arbors, etc., should be brought in and the necessary changes made so that they will be available when wanted. Only in very rare instances should a moulder have to wait until an arbor or a ring is looked up and brought into the shop.

Special Features—If special gaggers, rods, or clamps will be needed they should be made on the day previous so as to be in readiness when wanted.

Conditions—Changes in conditions should not be slighted. A job may take a special mix of sand; a pit may have to be dug; a large amount of heap sand may be needed; brick may be used, or something else possibly varying from the ordinary method of procedure may have to be done, and the time to do it is certainly not when the moulder is at work.

NIGHT WORK—The man in charge of the night force should be informed as to his share of the work necessary to carry out the procedure as scheduled. Castings should be shaken out and taken to the cleaning floor; gaggers removed from the sand heap and placed on the back end of the floors; sand tempered and put in condition for use by the moulders in the morning, and the flasks not needed by the men taken from their floors. Pits should then be dug according to the sizes needed for the work to be made in them.

At any rate, a proper knowledge of the plans plus careful preparations will assist materially in getting everything in readiness. There is no excuse, except perhaps in the case of breakdown jobs, for work to be held up because something has been overlooked. Wise planning will see further than the day following—it will look two or even three days ahead, so that if a flask has to be made or rigging planned, the work can be begun a day previous to scheduling the jobs.

CARRYING OUT THE PLANS AS PER SCHEDULE—This is a subject of vast importance. Planning in itself may be careful and thorough; preparations to carry plans out may be up to standard, but unless the actual procedure is one which does things according to the schedule, the results will not be forthcoming.

In the first place, the first hour or so in the morning is really the most important time in the day. There are a lot of men to be attended to; flasks, patterns and rigging must be distributed, and it cannot all be done at once or to advantage unless there is some organized arrangement. The following plan, therefore, seems to fit:

1—The night force, after the regular night work as outlined is done, should (according to the schedule furnished the night foreman) place on the moulder's floors the large flasks that are to be used, in which should be placed the large patterns. If pits are to be used, the patterns should be placed near them. This will lighten the work of the cranes to quite a degree.

2—About a half hour before the regular starting time in the morning, the laboring force should report and distribute the smaller patterns and flasks.

3—As soon as work is begun in the morning, whatever may be necessary in the way of rigging should be taken to the floors.

4—A man should be placed in charge of the laboring men, whether they directly assist moulders or not, to whom the moulders can make known their wants and he should be held responsible for seeing to it that they get what they want as quickly as possible.

5—There should be a regular place for the supplies, etc., listed previously, and the knowledge of their location should be in possession of all concerned.

6—Facing sand (which should be mixed in advance) should be kept at each moulder's floor and replenished as necessary before (not after) the men may need some.

7—The labor foreman should keep careful watch over the needs of the men as to copes. There is no excuse for a moulder asking for his cope only to find that it is at the bottom of a pile.

8—The moulders should be kept supplied with tools and equipment and should report when they need such things. I recently saw a moulder trying to mend a mould in the dark. Someone had stolen his torch and he was afraid to mention the matter for fear of being called down for his carelessness. There is certainly no money in such a state of affairs.

9—Cores should be furnished the men in advance of their requirements. They should never be made to go for them.

10—The crane service should be watched very, very carefully. "A whole mouthful," a foundry foreman recently said when this was mentioned to him. True, but a study and ingenuity will find ways to keep the delays due to crane waits at a surprisingly low point.

11—The general shop labor should be made to *jump quickly* when moulders want such things as gaggers, clamps, etc. The idea is to save time and if two steps can be taken instead of one, things will be further ahead.

A pretty large contract this? Certainly—an ideal state of affairs—an ideal that many a foundry can come within reaching distance of, if the work is properly organized, in the hands of a hustler and everyone made to do his part. It means work, of course, but no one ever accomplished anything worth while by weak, half-hearted trying.

Why necessary? *To save time that can be utilized in turning out castings.* Do not count by the usually accepted standards—the hours time or the wages expended per hour—but by *the pounds you can produce in every hour saved at the value per pound.* Your men are your investment on which you win or lose. Arrange it so that they can work to the best advantage and you are assured excellent dividends in extra tonnage. They will not only like it, but will show their appreciation by exerting themselves in order to stay with such a progressive concern. You will like it, too, for after all you measure your likes and dislikes in the foundry business by the size of your bank account after you balance up. The suggested procedure will help you to increase it.

THE ELECTRIFICATION PROBLEM ON TRUNK-LINE RAILWAYS.

By A. D. Williams.

Mr. Williams' statement of the problem of railway electrification recognizes frankly its seriousness and points upon which the railway manager must still be convinced by the electrical engineer before any general revolution in methods of operation can occur.—The Editors.

ELECTRIC traction has successfully met several problems of heavy railway traffic, and their solution seems a step toward that eventual electrification of the main line which is the dream of the electrical engineer. However, all these installations have been the result of peculiar local conditions and no two of them are alike, except in the fact that traffic passes through a tunnel. The New York Central Railroad uses the under-contact third rail and 600-volt direct current in the terminal electric zone, while on the West Shore near Syracuse some local traffic is handled by a third-rail installation which will not interchange with the terminal zone. The New York, New Haven & Hartford uses 25-cycle single-phase current at 11,000 volts, delivered by an overhead conductor east of Wakefield, and direct current on the New York Central tracks over which it reaches the Grand Central Station. At the St. Clair Tunnel the Grand Trunk has adopted the single-phase system with an overhead conductor, while the Detroit River tunnel of the Michigan Central uses direct current and the third rail. A three-phase system with overhead conductors has been installed at the Cascade Tunnel, while the Pennsylvania Company uses the third rail and direct current for their New York Terminal. All of these installations operate through tunnels. The Illinois Central, however, has indefinitely postponed the electrification of its Chicago terminal where tunnel operation did not enter the problem, and the railroads centering at Boston, Massachusetts, have reported that electric operation would be so excessively expensive that it was practically prohibitive—a conclusion similar to that reached by the Illinois Central.

The electrification of a trunk line carrying a diversified and heavy traffic is not a simple matter, and many of the problems which must be met and overcome are so far beyond the province of the specializing electrical engineer that he does not seem to realize the vital bearing which they have upon the electric-traction problem. The electric-traction engineer has been trained in the design, construction, and operation of street-railway systems and interurban lines upon which the traffic and operating conditions are radically different from those met with upon railroads. Upon these arteries of commerce all classes of traffic must be accommodated and kept moving, and any interruption in the service for an extended period results in serious industrial complications throughout the territory served. A delayed passenger train spoils many opportunities. To the general public this is the only evidence of railway operating difficulties, and it is usually dismissed with the comment "That qualified train's late again," unless there is a wreck and a newspaper article. Freight wrecks are unnoticed, generally, except by those to whom the goods are billed. It is only when some general strike or a natural cataclysm has paralyzed the railroads that the people commence to realize how dependent upon them they are. Under the most favorable conditions railroad operation is not one dream of bliss, even on a four-tracked main line, and the odds against the operating official increases as the number of tracks decrease. When the track goes out before the irresistible hand of natural forces beyond control, then traffic must be detoured; but it cannot be stopped as long as there is any possible means of getting it to its destination. This may mean a few or several hundred of miles extra run for passenger trains and for perishable freight. With steam as a motive power, each train is an independent unit and can be run as long as fuel and water are procurable and the track is in any shape to put a wheel over it.

It is true that the foregoing is an emergency measure, but the railroad official knows it is not uncommon, and the ability to cope with such obstacles to operation is inherent upon the ideal simplicity of operating each train from its own power plant. Herein lies the advantage of the standard gauge and the uniform equipment diagram to which practically all the steam railroads of the United States conform. The steam motive power and the cars of one line can be operated over any other line.

When the subject of electric traction is approached a diversity of systems is found in actual operation, and other and as yet untried systems are advocated as affording substantial advantages over those now in use. The railroad executive, keenly alive to the vital necessity of a uniform system upon all lines, is naturally bewildered and perplexed by these strenuous advocates, each presenting some favored system and condemning its competitors by faint praise. Some one system of electric traction must be the best, and all others will ultimately be relegated to the scrap pile; but he is called upon to choose between direct current at two voltages, and single-phase or three-phase alternating currents of a wide variety of frequencies and potentials, the electrical company offering to supply any variety desired, but not taking any decided stand for a particular system. It is imperative upon the railroad to be conservative; every item of equipment must be paid for and must earn enough to pay for itself and its replacement. The apparatus which cannot meet this requirement before it lands in the scrap heap will result in an enormous deficit, and bankruptcy with its attendant financial disaster, carrying down thousands of the holders of stocks and bonds to ruin, will be the fate of the road which hazards its future upon unsound and questionable progress.

Unlike the electrical engineer, the railroad man realizes that the existing installations of electric traction were made to meet extraordinary operating conditions; that these installations are widely separated, and so located that in the case of a breakdown of the electric system steam motive power can be rushed into the electric zone from adjoining divisions. Already one case has arisen where this step was necessary, as a snow slide carried away all the overhead construction at one end of the Cascade Tunnel and swept all the electric locomotives down into the gorge. It was announced that electric operation would be interrupted for several months by this accident.

With steam traction all kinds of emergency operating conditions can be readily met, as the motive power of one road can be operated over adjoining roads, and with electric operation it will be absolutely necessary to have equipment of an interchangeable type, for the reason that it could hardly be expected that a connecting line would be able to supply motive power for the trains detoured over its lines as well as for its own trains. Current for operating it might be able to supply, but only by serious limitations on the number and weight of trains, though assistance on this score might be feasible by the interconnection of power plants. Trackage rights are all that can be expected in a case of this kind and trackage without motive power cannot be used. It is true that the single-phase locomotives of the New Haven Road are operated for a portion of their run upon the tracks of the New York Central with 600-volt direct current, but in this case the motors were especially designed for this purpose and means are supplied for the control of both direct and alternating current. It can hardly be claimed that a locomotive of this kind is the ideal of simplicity. The New York Central locomotives cannot be operated except in their own electric zone. Should it ever become necessary to send trains down the west side of Manhattan Island, owing to the blocking of the inlet to the Grand Central Station, this could be done at the present time by the use of steam locomotives, abandoning the electric at Spuyten Duyvil.

It is undoubtedly true that each of the systems of electric traction possesses advantages for certain peculiar classes of work, but railroad traffic cannot be governed by fixed laws; it varies from day to day, and motive power and cars must be shifted from division to division to handle it. In passenger service, a football game at New Haven, or the boat races at New London, mean in addition to the regular daily schedule from sixteen to twenty extra trains of about nine cars each each way to carry the crowd, besides the addition of extra cars to the regular trains. All this extra traffic is crowded into a very short period and the difficulties of handling it with a supply of motive power just adequate for normal conditions is something which cannot be appreciated by the layman. Freight congestions rarely reach such a stage that the public becomes aware of their existence, but on occasions the Pennsylvania Railroad has been forced to place an embargo on perishable freight for certain points. In the west emergencies have arisen which caused the Denver and Rio Grande to lay out express passenger trains in order to rush train loads of coke to the smelters on passenger schedule. Upon more than one occasion the second section of the famous 18-hour train has been a fast freight carrying silk or the new tea for Transatlantic shipment. The lesson of the emergencies is that any motive power of a specialized character must be very carefully considered, and its zone of service so delineated that it will never prove the neck of the bottle.

Before any real progress in electrification can be made the battle of the various systems must be settled upon broad-gauge lines. The motive-power question is one of the biggest problems in railroading. It offers one of the most attractive fields for speculation on its progress, and the electrical man sees in it the prospects of an enormous amount of business; for this reason the advocates of electric traction must not permit themselves to become blinded by its brilliancy. The efficiency of electric traction is not a question of systems, but of cold cash. Will it pay? In the settlement of this question operating expenses, safety, flexibility, first cost, depreciation, interest, and the financing charges must all be considered. The number of cycles, phases, and the kind of current are of no importance whatever to the big railroad man, the one who must be convinced. In order to get his attention it is necessary to eliminate all the details and reduce the problem to the limits of a single letter sheet.

THE TWELVE PRINCIPLES OF EFFICIENCY.

By Harrington Emerson.

IX. THE SEVENTH PRINCIPLE: DESPATCHING.

Mr. Emerson's formulation of the definite principles of efficiency, which began in our issue for June, 1910, is attracting a growing momentum of interest and appreciation. It is exercising a force upon industrial thought that promises to influence materially the economic future of production, transportation, and the engineering activities generally. The first five principles—Definite Ideals, Common Sense, Competent Counsel, Discipline, The Fair Deal, are principles of conduct. The remaining seven—Reliable, Immediate and Adequate Records, Despatching, Determination of Standards, Standard Practice Instructions, Standardized Conditions, Standardized Operations, Efficiency Rewards—are principles of operation. Mr. Knoeppel's article, elsewhere in this issue, (page 745) shows how this seventh principle—Despatching—is practically applied in foundry operation.—THE EDITORS.

THE Eskimo counts days by sleeps, counts months by moons, and counts years by long snows. He despatches himself by the seasons. The Egyptians knew that days varied in length, that the moon was no despatcher of seasons, and that the sun was no despatcher of the year, so they fell back on Sothis, the dog-star, and based their chronology on the great Sothis period of 1,461 years. Our watches and chronometers run on sidereal time.

With our photography, with our spectroscopes, we find that in one direction the stars are widening out, that in the opposite direction they are drawing together, as our solar system swings through space; and ultimately we shall fall back on the whole universe as chief despatcher.

So much for the infinitely large; but despatching is just as much in evidence in the infinitely little.

In three weeks' time, a hen's egg, if kept warm, will change from an albuminous and fatty mass into the living chick. As boys in an English school we secured cards of silkworm eggs, hatched them by the heat of our own bodies, carefully reared the worms, watching the alternate periods of voracious activity and sloughing numbness. We watched them spin their cocoons, within which they changed to crysalids, to emerge later as delicately beautiful moths—unless we cut short their despatching and despatched them our way with boiling water. All growth and decay are manifestations of the principle of despatching. The emanations of radium, that marvelous element, have almost revealed to us the ultimate constitution of matter, and we now know that every atom is in a ferment of activity, as orderly as and perhaps far more complicated than a solar system.

The Egyptians had wrested from the stars their time secrets and arranged accordingly their dynasties, also their great Sothis month once in 120 years, a leap-year month; but they did not know that ophthalmia is carried by filthy flies and that it grows in each case as regularly as solar cycles. So from the prehistoric paleolithic age to the last decade, Egyptian babies have gone blind with preventable blindness.

It is apparently easier to grasp and acquiesce in the large than in the small, easier to rush to certain death in a battle than to endure a cinder in the eye, but he that ruleth his spirit is better than he that taketh a city.

At every hotel there are racks filled with railroad time-tables. These are issued by the ton every month and show to the minute the exact time during the future weeks every passenger train in the United States is scheduled to reach every station. These are the popular, abridged time-tables. For the employees there are time-tables much more carefully compiled, covering also the freight trains and giving all the rules of operation.

In railroad operation marvelous despatching has been attained, more accurate than the seasons, more reliable than the tides, almost equal to the star time on which it is based. Lines of track nearly a thousand miles long stretch between New York and Chicago. Every switch, every grade, every curve, is known; the line is studded with signal towers and punctuated with stations. In the round house is a locomotive with boiler capable of carrying 225-pounds steam pressure, which through the cylinders and pistons pushes on the wheels with rims polished like glass. The rims transmit 400 horse power through a quarter-inch square of contact with a glass-smooth rail. With one load of coal, drinking from tanks as it runs, the locomotive is able to speed 140 miles at the rate of 60 miles an hour. The seventy-two to eighty-four wheel axles under the train must each run true in its box, everything in track and equipment, in men, and above all in spirit, must be in perfect order all the time. On the basis of these conditions a schedule is made out, a schedule of running time, with due allowance for grades and curves and stations, an 18-hour schedule from New York to Chicago. The train is then despatched.

The despatchers issue orders to the conductor and to the block-signal men, thus controlling the train from both ends. While under the orders of the conductor, while physically under the control of the engineer, it is the despatcher who from start to finish holds it in the hollow of his hand. This is the highest degree of despatching that has been reached in America. It is perfect in its way, and all Americans are justly proud of it, although as a marvel of human skill and despatching excellence it is not to be compared with the despatching of the Franco-German war by von Moltke, when over a million men were despatched, and empire-making and destroying battles were fought at a predetermined time and place, with predetermined victory for the great despatcher, predetermined defeat for his less skilled opponent. The big task was carried through because of perfect preparation. The German army had no track, no perfect locomotives, no built and tested signal towers, but it had a perfectly working organization that had not omitted to give attention to every little detail.

In America we fail in details. We step from the 18-hour train and we enter a railroad shop. We ask, "Do you despatch your work here?"—"No, this is a repair shop. We rarely do the same thing twice. Despatching is all very well for a daily train running every day in the year, but it would never apply in a repair shop." The official in charge with ill disguised skepticism enquires whether the questioner is a railroad man, whether he understands the peculiarities of railroad operation. We say nothing, but we wonder whether a surgeon without railroad experience could take out a railroad man's appendix. Has the official fully grasped the fact that as to most of life facts, as to the fundamentals of conception, gestation, birth, nutrition, growth, development, he is one with his cousins, the other mammals; that as to most of the balance he is one with his human brothers, and that even if he had the special talent of a Paderewski, he could not play without hands, nor compose if he had the toothache, nor appear in public barefoot. We wonder that the official does not see that the laws of order, of sequence, of rhythm, of balance, and several others are superior to all minor peculiarities. Once when I was suddenly stricken in a railroad shop and was taken, distorted with pain, in an ambulance in my grimy, disheveled clothes to the railroad hospital, they thought I was a tramp who had fallen off a brake beam, but neither I nor they were worried about my official standing as they tried to mitigate the sufferings of a sick man.

To return, not to this railroad shop, but to the other where the doubting official is standing, I suddenly see a man shaping a small piece of steel about the size of a visiting card. I do not know what it is for, but in thirty seconds I notice that the moving tool is cutting air three inches and cutting metal one inch; efficiency of stroke is therefore about 30 per cent, with due allowance for clearance at each end. I ask the man what kind of tool steel he is using, and he answers "blue chip," but this means nothing to him, as instead of making blue chips his metal chips are dull grey. His cutting speed is about one-third of what it ought to be, therefore efficiency of speed is 30 per cent. His tool is diamond-pointed and his feed is 1/64 inch. He should have used a round-nosed tool and the feed should have been 1/16 inch, so that the efficiency of feed is 25 per cent. His depth of cut is as thin as he can make it, so he takes three so-called roughing cuts and then a finishing cut when one deep roughing cut and a broad, scraping, finishing cut would have answered. His efficiency on depth of cut is not over 50 per cent. The time efficiency of the whole job is therefore $30 \times 30 \times 25 \times 50 = 1.125$ per cent—but a little over one per cent. These are the visible inefficiencies. I surmise a number of others that I do not see. I suspect that perhaps the piece was not needed at all, that some worker or foreman is doing some unauthorized experimental work; I suspect that the piece needs no such finish. I have too often seen infinitesimal cuts, followed by file and emery cloth, put on a piece that is then flung down on the rough floor and badly dented with no apparent interference with its usefulness. I have seen a scraping tool put on locomotive tires, taking off tissue-paper-thin scrapings, when everybody who thinks a minute knows that car axles (a much more important surface) are often given a rolling finish, and that locomotive tires, however rough, would roll smooth before the engine had rolled out of the shop. I have seen a railroad shop man put hours of work and use $600 of material on a replacement when a $27 repair would have abundantly answered the purpose, a man not heeding the Scripture injunction not to put a patch of new cloth on an old garment lest the garment be weaker than before. Why continue these painful examples?

The railroad that despatches its crack trains with 99 per cent of time accuracy has either no despatch system or a very crude one for work, either big or small, through its shops; therefore in some cases it fails to realize an efficiency of even 1 per cent, and on the big average of all shop work fails to realize either a time or cost efficiency of more than 40 per cent. Our universe would not last very long if only the stars were despatched. It is the despatching of our daily meals, the despatching work of ferments, of bacteria, of protozoa, of molecules and of atoms, that counts.

A firm in Chicago has taken a million-dollar contract to bring out a new edition of a great encyclopedia. All the work is despatched. Conditions were standardized, operations were standardized, each volume, each page, each column, each line, each letter is despatched, even as the proper lubrication of each car axle is part of the proper despatching of the 18-hour train.

Many years ago on the Yukon I said to a river-steamer owner, "I suppose you much prefer passengers to freight. If you run on a sand bar, the passengers can get off and help you to put the steamer afloat." He told me plainly, forcibly and picturesquely that I did not know what I was talking about. If a passenger boat stuck on a bar, the passengers did nothing but grumble and cause trouble, and the only way they lightened the load was by eating more of the food, but a load of freight would not complain if it not only ran on a sand bar but in addition was caught in the ice all winter.

Railroad despatching as to passenger trains is of a very high order of excellence; as to freight forwarding it is gradually emerging from the dark ages, perishable freight going forwards almost with passenger regularity; wrecks, slides, snow are taken care of with a despatch of the highest order of excellence; railroads are even built on schedule time; but considering the expenditures that are not despatched and those that are inefficiently despatched, the general despatching efficiency, even of railroads, is not over 40 per cent, yet there are few activities that do as well as railroads. The reasons the despatching efficiency is so low are many, but chief among them are lack of proper type of organization, and failure to apply principles as distinguished from empirical makeshifts.

Nevertheless there are very few other activities scheduled as far in advance and as accurately as train despatching. Newspaper offices furnish wonderful examples of scheduled work, so also do theatres, and perhaps the most wonderful of all are the weather reports, gathered over an area of four million square miles, compiled, digested and distributed within a few hours of receipt. But most of the industrial plants of the world are still in the stage of civilization of which as to transportation the old freight wagons and prairie schooners across the plains were types. They started when they got ready, they arrived some time, and nobody knew where they were nor what route they were taking in between.

There is one collection of industrial shops in the United States in which schedules and despatching have been so perfected that the work is planned ahead three months and the particular job that each man is to do at 4 o'clock or any other hour for any day is known. Planning long in advance is convenient, but is not an essential part of scientific despatching. A barber shop is scientifically despatched from minute to minute, and a customer entering can figure very closely on the time that he will be able to leave.

Railroad despatching remains, however, the most extended and striking example of advance planning and daily realization. It seemed quite obvious, therefore, to extend these railroad principles of despatching to the operations in a railroad shop. Railroad officials fully understood what despatching meant, were accustomed to work under its rules. It proved nevertheless a very difficult task. In the running of trains a very great deal precedes despatching. There is a carefully worked out schedule which has been more or less tried out for months. How many of these conditions are present in the industrial shop? Where are the standardized conditions, where are the standardized operations? Where is the discipline, where is the maintenance, and where are the schedules?

Railroad shops as to despatching are in the same backward condition as most industrial shops. Therefore it was found that despatching by itself could not be applied, that many other preparations were necessary, that if the application of other principles was worked out, despatching would become easy.

The application of principles will change a mob into an army, whether in field or shop. The frenzy of a mob shows itself in a lynching, but the courage of an army ought to be highest in defeat. When men, foremen, officials, equipment, supplies, had been subjected for a year to the operation of principles, a beginning was made of despatching locomotive repairs. The subject was attacked from both ends at once. Locomotives were worth a great deal to the road, a day's service being estimated at $35; therefore the first plan was to despatch the repairs as a whole, locomotives to be returned to service in 12 days, 18 days, 24 days, according to the class of repair. The second plan, worked in with this, was to despatch each separate item of work and to pick out those items which, taken at the proper time, in the proper order, and in the proper sequence, would result in completing a locomotive in the shortest time.

It is interesting to note in the matter of repairs the great superiority of marine repair despatching over locomotive repair despatching. A big vessel will be put in a dry dock, at $5,000 a day charge perhaps, and be completely scraped, repainted, new propeller and rudder fitted, new plates inserted, in perhaps three days. Complete circulating pumps, from drawing to installation, will be completed in three days. Where individual operations are summed up, many of which can go on concurrently, it is hard to defend a longer time than 72 hours for most locomotive repairs.

It is also interesting to note that in the sister branch of railroad maintenance, namely, track repairs, stupendous tasks of snow and landslide removals, bridge rebuilding, etc., are accomplished in hours rather than in days or weeks.

It is evident that brain must count for more than muscle in attempting to apply despatching to locomotive repairs. We had to know that men would be available, therefore discipline and the fair deal both had to be strengthened; ideals of order, of promptness of economy had to be instilled; common sense had to be applied; records had to be started, but other principles also had to be applied. Conditions of all kinds had to be standardized, operations had to be standardized, schedules had to be made out, and definite instructions had to be issued. It is really very much easier to apply a few principles than to remedy several million defects. The easiest way is to forget these defects in the past, ignore them for the present, but constantly obviate them for the future.

A new plan was gradually substituted for the old plan. In the railroad shop major schedules were worked out and put into effect by despatching; minor and subsidiary schedules were made out for each job, each man, and each machine, the lesser jobs fitting like parts of a puzzle into the larger schedules, and on the basis of schedules, however often they were changed, men, machines and jobs were despatched. All work, instead of passing directly from foreman to worker or to gang, passed through our despatch board. Practice was perfectly elastic, but procedure was not. Schedules could be changed on a moment's notice and also the sequence of despatching, but not the fact of despatching. The particular shape and size and location of despatch board is unimportant, the essential being that it is suited to the work. Whether the despatch board is covered with parti-colored strings, or made up of hooks, clips, or pockets to receive cards, is also unimportant in principle, but not in practice, since a method under which many of your despatching cards blow out of the window soon becomes inoperative.

The name *despatching* was adopted from train despatching, and train operation organization was adapted. The foreman corresponded to the engineer, a new official was created corresponding to the despatcher, a messenger and telephone service kept the despatcher's office in touch with the work. Despatching records, however, were adapted from bank practice. The receiving teller takes in money, he enters the amount in the depositor's time book, he credits the bank's cash book with the amount received, but he also credits the ledger account of the depositor. When the depositor draws a check it is presented to the paying teller who hands out the cash, charges the cash account, charges the depositor's account. At the end of any day the total cash in hand must correspond with the sum of the balances in all the accounts. Similarly the despatching board, like the cash book, is filled with prospective work. As fast as any item is performed it is charged to the order. The operator is charged with the pay he draws and credited with the work he performs.

There must be at the day's or week's or month's end a perfect balance between all work credited to operators and charged to orders, also a perfect balance between wages and other accounts charged and totals credited to work in progress and delivered since last balance. The records are immediate, absolutely accurate, and wholly adequate.

In practice it has proved more important to despatch unstandardized work than to standardize undespatched work, even as on railroads it is more important to despatch trains even if there is no adherence to schedule than it is to run trains on time without despatching.

Despatching, like other principles, is a subdivision of the science of management, a part of planning; but while visible to the eye as a distinct pattern, it ought, like inlaid work, to be intactile. If we are well nothing is more beautifully despatched than the food we eat, from plate to building up of depleted hidden tissue. We are only conscious of the pleasure of the first taste, not conscious of the admirably regular way each molecule is ultimately despatched to its destination.

EDITORIAL COMMENT

A Critic of Efficiency.

A CONFUSION of ideas and a fallacy of argument appear in Mr. Warren S. Stone's address before the National Civic Federation at its recent. conference. Mr. Stone is quoted as asking, about an advocate of efficiency: "Has he ever shovelled coal into a locomotive? No; and yet he makes the assertion that the railroads waste half their coal. I have shovelled more coal into locomotives than could be piled on two of your city blocks."

To measure a man's knowledge of possible economy in fuel combustion by the tonnage of coal he has shovelled is a good deal like testing the skill of an architectural engineer by the thousands of brick he has laid or, better, taken up the ladder. Has he ever carried a hod? No; and yet he asserts that steel construction is more efficient than brick!

There have been many betterments in the efficiency of fuel combustion in stationary steam plants during the past twenty-five years, and the best today probably saves half the coal used in the good average practice of a quarter-century ago. The waste of fuel was due to imperfect apparatus, appliances, methods, knowledge—not to wilfulness of the firemen. None of the betterments was made by the men who shovelled coal through the fire doors. None of them has increased the labor of the men who shovelled the coal. Many of them have lightened that labor. None of them has lessened the number of jobs for firemen wanting work. On the contrary, the reduced cost of power has increased enormously its use and the number of firemen employed.

If similar improvements had been made in locomotive firing, so that one city block full of coal could do the work of two, Mr. Stone's labor of shovelling would have been only half as exhausting, while his pay would have been the same. The other block full of coal would have been conserved for productive uses, employing other men. Mr. Stone's job would have paid just the same, and some other man would have got a job at equal pay shovelling the other half of the coal. The value of that second city block of coal would have remained in the railroad treasury to do useful work, employing more men. It is hard to see how even from the most selfish interests Mr. Stone can so savagely insist upon shovelling that second city block full of coal, and refusing to have any one save it or save him from the 50 per cent of useless, profitless waste.

Anti-Machinery Riots Modernized?

ANOTHER official expression from the railroad employees has been voiced by P. H. Morrissey, president of the American Railroad Employees and Investors Association, and P. J. Dolan, general secretary of the International Brotherhood of Steam-Shovel Men. They say: "The suggestion (scientific management) contemplates the reduction of the operating force by thousands of men. . . . They (the unions) want more men to lessen their burdens, instead of less men and greater burdens." And so forth. It is the old blind cry that labor has always raised against mechanical (i. e., scientific) improvements. The stage-coach drivers at the beginning of the nineteenth century opposed the railway with the same objections, with the same earnestness, in almost the same words, that Messrs. Morrissey and Dolan present today.

Efficiency methods do not impose greater burdens; they lighten existing burdens by removing the difficulties, the obstacles, the useless and fruitless efforts and movements that so generally lie between the man and the actual accomplishment of his job. The causes of inefficiency where labor is concerned are not generally that the employee does not work hard enough, but that a large part of his work is expended on wholly useless things that do not profit him or any one else—Mr. Stone's firing all day long, for instance, twice as much coal as should suffice.

It may of course be argued that where labor is concerned this must result in fewer men performing any fixed quantity of productive work, and therefore in throwing of some men out of work. Theoretically, the proposition is correct. Actually, it is the opposite of truth. This is partly because the quantity of work is *not* fixed, an enormous increase of demand always appearing as soon as the work is more economically done. It is partly because these changes never proceed and never can proceed by sudden revolutions, but by slowly progressive evolutions; and the labor which is released from the old wasteful effort is immediately and progressively absorbed by the increasing opportunity for the new and more efficient effort.

There can be no such rapid introduction of efficiency methods that the country will run any risk of being "plunged into industrial warfare" by these Tories of industrial politics, who have so long held the old labor-union creed that they can not understand, and hence they fiercely denounce, the statement of a new gospel that is full of hope for the whole country, and most of all for labor The progress toward more scientific management will be gradual, spreading quietly from many centers of growth. It is interesting even now to note that while those who feel themselves subservient to railroad interests are, as they believe, catering to those interests by violent attack upon the principles and the preachers of efficiency, some of the greatest railroad men in some of the greatest railroads of the United States are giving these principles and preachers their serious, respectful, and conscientious attention.

State Aid to Technical Education.

AN earnest and able argument for substantial State appropriations in support of the Massachusetts Institute of Technology has been made by its President, Dr. Richard C. Maclaurin. The "Tech," as he shows, is an institution founded by the State, bearing its name, with State representation in its governing body, doing work for which similar institutions elsewhere receive large State support, and at present contributing directly about $200,000 per annum in excess of all tuition fees for the education of the youth of Massachusetts.

To maintain high standards of efficiency and quality in engineering education, a constant and large increase must be made in personnel, equipment, and facilities. The technical school that does not meet these requirements is retrograding, and the utmost devotion and work by its teaching staff can only partially and temporarily check the rate of the decline that results from stationary or parsimoniously increased appropriations. The Massachusetts Institute of Technology recognizes this need clearly, and turns to the State as the natural provider of the funds that it seems difficult to secure elsewhere.

President Maclaurin makes his case. He ought to have the money if he wants it. Nevertheless, it would be happier to see the funds provided from some other source. State—or any political—affiliations do not seem good for a university in the long run. The connection may not be proven, but there seems to be risk in accepting State aid, and with it by implication increased State control, and another solution of the financial problem, if possible, seems desirable; but this is a consideration to be weighed by the Institute and not by the State.

REVIEWS-ADVANCED PRACTICE

NOTABLE ARTICLES OF THE MONTH IN THE SOCIETY PROCEEDINGS
AND TECHNICAL PRESS OF EUROPE AND AMERICA

THE CLINKERING OF COAL IN BOILER FURNACES.

A GENERAL VIEW OF THE SUBJECT, AND A SUMMARY OF RESULTS OF TESTS FOR THE EFFECT OF VARIOUS CONSTITUENTS IN THE ASH.

Lionel S. Marks—Engineering News.

SCIENTIFIC experiment has had little to do with the development of knowledge of the causes of the clinkering of coal and of means for its prevention or reduction. The information at present available is almost entirely based upon the results of general experience, and while it is satisfactory so far as it goes, it does not meet the demands of modern boiler practice. Special interest attaches, therefore, to a long paper on the subject by Prof. Lionel S. Marks, contributed to *Engineering News* for December 8, 1910. Prof. Marks' investigations, it is true, have given results which are almost wholly negative; he offers no universal remedy for clinker troubles, and no means of palliation except the use of the well known steam-jet apparatus. But his clear exposition of the whole subject, and the authority of the conclusions he draws from his scientific research make his paper none the less a very interesting and valuable contribution to power-plant literature.

The objection to clinkering is mainly economic: it increases the cost of the heat liberated from the coal by decreasing the efficiency and capacity of the furnace, by increasing the labor cost, and by shortening the life of the fire bars and of the fire-brick lining. Occasionally it may interrupt entirely the operation of an industrial plant by clogging up the moving parts of a moving grate. From the point of view of the coal user, there are two principal methods of reducing the economic loss due to clinkering. The first is by drawing up coal specifications in such a way as to penalize a clinkering coal in proportion to the loss it will cause; this method, however, presupposes the possession by the coal user of information not at present available—information which will enable him to predetermine, by tests on a sample of a coal, the behavior of the coal in the boiler furnace. The second method is by reducing the clinkering resulting from the normal combustion of any given coal. Prof. Marks' investigations have had for their principal object the determination of the conditions under which clinkering can be diminished, or modified and controlled so as to give less trouble. He discusses also the possibility of obtaining the information required for the application of the first method mentioned.

Clinkers result from the fusing of the ash content of coal, and it is presumably true that the amount of clinkering depends on the composition and amount of the incombustible residue, and also, probably, on the amount of sulphur present. While it must be borne in mind that the caking of coal, determined principally by the hydrocarbons, may have considerable influence on clinkering, it seems permissible to disregard the carbon, hydrogen, oxygen, and nitrogen, except in so far as their relative or absolute amounts may determine the temperature of the fire. The incombustible matter, upon which the clinkering mainly depends, may be divided, according to origin, into four classes. The first class includes the ash originally in the wood from which the coal is derived, which may be generally expected to amount to 1 to 1½ per cent. of the weight of the coal, and to comprise, on the average, 0.3 per cent. carbonate of lime, 0.2 per cent. magnesia, 0.15 per cent. phosphates, and 0.3 per cent. silicic acid. The second class of incombustible matter includes the material, generally argillaceous and siliceous, deposited as silt among the fallen wood from which the coal is derived, which must be considered as part of the true ash of the coal, and which is in fact the origin of the greater part of the ash in ordinary clean coals; this class includes also the salts of calcium, silicon, and other metals precipitated in the wood, the probable origin of most of the sulphur in coals. Calcareous, siliceous, or argillaceous material from the walls of a coal seam, the result of careless mining and washing, constitutes the third class of incombustible matter. The fourth class comprises accidental additions of iron, dirt or other foreign matter to the coal in transit.

If the coal from any given source clinkers always under normal operating conditions, it may be assumed that the clinkering results from the presence of the true ash, and there is no difficulty in obtaining a fair sample of the ash which is giving the trouble. If clinkering is only occasional, it will be due either to a higher temperature than usual or to other changes in conditions, or else to the presence of impurities of the third and fourth classes mentioned above. When the presence of impurities of the latter classes is the cause of clinkering, it is practically impossible to get a fair sample of the ash, because of the unequal distribution of the impurities throughout the mass. The detection of causes of occasional clinkering is consequently very difficult.

Certain attempts have been made to relate the clinkering of coal to the chemical composition of the ash. With the object of finding whether there are any general characteristics of coal ash, Prof. Marks has searched the literature of the subject for all available chemical analyses in all parts of the world. A thorough examination of the data collected fails to reveal anything that may be regarded as a general characteristic of coal ash, as distinguished from ordinary rock substance. The number of constituents is always large and the variation in the percentage present of the various constituents is extreme. With this enormous variation in the composition of the ash it seems hopeless to expect that any set of investigations of practicable extent could clear up the relation between the composition and the clinkering of ash.

"Clinkering is the result of fusion and is some function of the fusibility of the ash. But it is impossible to consider fusion without taking viscosity into account. The fusing temperature of an ash is not necessarily, is not generally, a single-valued temperature. At some particular temperature, some one constituent of the ash will melt; if it is a minor constituent the effect may be that the ash becomes a very viscous pasty mass. At higher temperatures other constituents may melt and the mass will become more liquid. In other cases the ash may become liquid as soon as the initial melting temperature is passed. It is evident that the viscosity of the melt will have an extremely important influence on clinkering. If the melt is very viscous, we shall get a sticky mass which will attach to itself the surrounding coal and ash and form a troublesome clinker; if it is more fluid it will run on the grate bars and will in part freeze there and may be difficult to detach; if it is extremely fluid and melts at a temperature very much below that of the fire, it might possibly flow from the fire like water and give very little trouble.

"There is in existence some information as to the fusing temperatures of ash materials of various compositions, but this information would have to be enormously extended before it became useful for the study of clinkering. Moreover, even if such information were fully available, it would necessitate the tedious and costly analysis of the ash before it could be applied; and even then, in the absence of exact knowledge as to the temperatures that would be reached in the fire, it would not be possible to foretell the behavior of the ash in an actual furnace. The very important question of viscosity is practically uninvestigated. Consequently, it appears that it is now, and probably always will be, quite impracticable to approach the subject of clinkering from the analytical side; and that little is to be gained from ash analysis unless it can be shown that certain fluxes are present in considerable amount."

Prof. Marks summarizes present knowledge and theories as to the formation of clinker and discusses Prost's formula for the relation between the fusing temperature of coal ash and the composition. He finds it unsafe to rely upon Prost's method. The general idea—that the temperature of fusion is increased by increasing the alumina and is decreased by substitution for alumina of other constituents—is undoubtedly sound; but in the present state of knowledge it is impossible to tell from a chemical analysis what will be the fusing temperature and how much trouble will arise from clinkers.

A very common view as to clinkering is that it is due to, or accompanies, sulphur in coal. The influence of sulphur is undoubtedly considerable in some cases, but the clinkering depends on the percentage of sulphur in the ash rather than the percentage of sulphur in the coal. When the percentage of sulphur in the ash is high, much clinkering is likely to result. Another common view is that clinkering is caused by iron. The presence of iron certainly results in a lowering of the melting temperature, and so far as the presence of iron means the presence of sulphur, there may be that secondary reason for clinkering. It is probable that the fire bars waste away wherever contact takes place with molten iron or with ordinary molten clinker, in two ways: first by direct melting, and second by chemical combination or solution. The latter is undoubtedly the more active agent, since the chemical combination or solution will in general result in a lowering of the melting temperature of the cast iron, and may be accompanied by evolution of heat.

Since it is impossible to predetermine, by chemical analysis, the degree of clinkering which is likely to result from the burning of a given coal under a given boiler, search must be made for some means of preventing or reducing clinkering, or, failing in this, means of preventing or reducing the loss of efficiency of combustion which results from clinkering. Four possible courses seem open:

1. Reduction of the temperature of combustion by increasing the air supply to the furnace. This will always be accompanied by reduction in efficiency, but badly clinkering coals should always be burned at low temperatures, as the reduction in efficiency from a large excess of air will not usually be so important as the losses from bad clinkering.

2. Prevention of freezing of clinkers on the grate by the use of steam blown in from below the grate. The steam is decomposed by the grate and the clinker, and not only prevents the clinker from freezing on the grate, but also tends to break the clinker into smaller masses. With some clinkers this method is not found to give much relief. The use of steam in this way should not result in any considerable reduction in efficiency.

3. Raising the fusing temperature or viscosity of the ash by mixing certain substances with the coal so as to prevent either the fusing of the ash or the flow after fusing.

4. Reducing the fusing temperature and viscosity by the admixture of various fluxes, so that the fused material will flow through the grates like water without freezing on them.

Prof. Marks' investigations have been devoted exclusively to remedies 3 and 4. The operation of remedies 1 and 2 is well known. The investigations were of two kinds: first, with the ash alone;

and second, with coal burning on a stationary grate. In the first series, which was intended to be merely preliminary to the second, ash and mixtures of ash with alumina, lime, sesquioxide of iron, iron pyrites, iron filings, calcium sulphide, and calcium sulphate were moulded into pyramids of the dimensions of Seger's cones and were heated in a gas muffle. On the observation of their behavior was based the selection of the materials mixed with the coal for the tests on the stationary grate. These materials were kaolin, pure silica, common yellow loam, crushed oyster shells, which had the same effect as lime, and three iron compounds, pyrites, limonite, and the simple sulphide. Both the kaolin and the crushed quartz materially reduced the clinker trouble, the lime caused very bad clinkering, and the tests with the iron compounds showed that both the iron and the sulphur cause trouble. Since neither kaolin nor crushed quartz is cheap enough to be commercially available, the results of the investigations have a purely negative value. Prof. Marks' conclusion is that the only real cure for clinkering is low-temperature combustion, obtained either by increased air supply or by the use of the steam jet.

An editorial on Prof. Marks' paper in the same issue of *Engineering News* enters at length into the question of the economy of steam-jet apparatus. Their comparative disfavor among engineers is due partly to the extravagant claims with which they have been exploited, and partly to their reputation as "steam eaters." An excessive steam consumption, however, is usually the result of negligence. With efficient steam jets, well maintained, it should be possible to deliver an amount of steam into the ash pit sufficient to prevent clinker without serious reduction in boiler economy. There is, in fact, considerable reason for believing that the presence of water vapor in a furnace does in some way tend to promote combustion. If it reduces the percentage of carbonic oxide in the flue gases, or the air necessary to secure complete combustion, the loss due to the passage of water vapor through the furnace may be more than offset.

THE TESTING OF STEAM TURBINES AND TURBO-GENERATORS.

A CRITICAL DISCUSSION OF THE VARIOUS METHODS, THE APPARATUS EMPLOYED, AND THE PRECAUTIONS TO BE OBSERVED.

E. D. Dickinson and L. T. Robinson—American Institute of Electrical Engineers.

IN a paper read at the December, 1910, meeting of the American Institute of Electrical Engineers, E. D. Dickinson and L. T. Robinson have given a highly practical review of methods of testing steam turbines and turbo-generators, of special interest to operating engineers. The authors point out that to those operating steam turbo-generators the only tests of commercial value are those made to determine the over-all economy of the complete unit. Their paper is a summary of the precautions which must be taken in order that the results may not be misleading, and a critical examination of the relative degrees of accuracy of different methods employed in tests of this character. Throughout they emphasize the necessity of exercising the greatest care in every detail of measurement.

The only positive method of testing a turbo-generator is to measure the steam that goes in through the throttle valve, and the electrical energy delivered at the terminals of the generator. The surest way of measuring the steam is to collect and weigh all the steam after it has been condensed; this method, of course, requires a condenser of the surface type. Two precautions are essential: first, that all the steam used in the turbine should be condensed and measured; and, second, that no steam or water not used in the turbine be allowed to enter the condenser. Leakage from the condenser tubes is a common source of error, and when it arises from split tubes which open only when the condenser is heated by the passage of steam, leakage is very difficult to determine. The condenser should be tested for leakage before and after each test; with all the steam turned off the turbine the condenser should be run for some time with full vacuum, and the discharge from the hot-well pump very accurately measured. No tests should be considered which do not show consistency with other tests on the same machine. The most accurate method of measuring the condensed steam is by the use of tanks so arranged that all the water can be weighed at equal time intervals during the test. The pump, piping and tanks must be free from leaks, and it is essential that the condenser and pumps be so arranged that the water will flow continuously to the pump.

When the turbine operates non-condensing or the condenser is of the jet type, recourse is frequently had to the method of weighing the water fed to the boilers. In tests of this kind the liability to error is very great, and every possible precaution must be taken to secure results of even reasonable accuracy. The steam piping connecting the boilers and turbine must be disconnected from all other piping and all openings must be blanked off; valves must not be relied upon. The outlets of all blow-off and drain valves must be visible. All piping between the feed pumps and boilers must be exposed and have no branches. The boiler leakage, which is most difficult to locate, must be checked before and after each test by closing the throttle to the turbine, or, if necessary, by blanking the pipes at the turbine and running a test measuring the amount of water required with full steam pressure on boilers and piping. The feed water used should be weighed and not measured by meters.

The method of testing by heat balance is based on measuring the amount of heat transferred to the cooling water from the condensed steam. On account of the difficulty of measuring the quantity of cooling water and its true average temperature change, the method is extremely inaccurate and unreliable, and at best can give but an approximate idea of the quantity of steam being condensed, even when all possible precautions are taken in the measurement of the quantity and temperature of the cooling water and the temperature of the outgoing water.

All tests should be run with fixed conditions for an appreciable time after a state of equilibrium has been established. The time required will depend on the nature of the test being made. In general, when small amounts are being measured, as in testing for condenser leakage, the duration of the tests should be somewhat greater than when large quantities are dealt with.

The net over-all efficiency expressed by the ratio between the kilowatt-hour output of the generator and the available energy in the steam is the only one of any particular commercial value. The data required for the determination of the available energy in one pound of steam comprise the pressure in pounds per square inch, the quality and temperature of the entering steam, and the pressure at the turbine exhaust. The last quantity should not be measured by an ordinary gauge, but by a full-length mercury gauge. If the steam be superheated the assumed figure for the specific heat should be given. In testing multi-stage turbines, measurements of the pressures in the different stages should be made, to reveal any abnormal conditions existing in the interior. The kilowatt output should be the net output after subtracting from the total output the kilowatts used for excitation.

All instruments, including meters, gauges, thermometers, and scales, must be very accurately calibrated or checked before and after the test. The turbines should be thoroughly inspected to see that all parts are in proper condition.

Whenever possible, turbines should be tested under the conditions for which they are built to operate. Corrections for different conditions are always liable to throw some doubt upon the accuracy of the test and therefore upon the efficiency of the machine tested. Different machines will have different correction factors for varying conditions, and for this reason it is impossible arbitrarily to fix the proper allowances. In general, corrections for steam pressure, moisture, or superheat, large changes in which affect only slightly the conditions in the machine, are less likely to be misleading than a correction for varying vacuum, since a slight change in the vacuum makes an enormous change in the available energy and volume of the steam in the low-pressure end of the turbine. A turbine which shows high efficiency with poor vacuum may, unless properly proportioned, show a low efficiency with good vacuum.

The majority of commercial tests on turbo-generators are made to determine whether or not the unit is fulfilling the guarantees made by the manufacturer. The complete test of a unit necessitates taking a large number of measurements, and small inaccuracies in taking many of the readings are liable to affect considerably the final results. For this reason, no machine should be discredited on account of small variations in the final results. With the high efficiencies now being obtained, small inaccuracies in readings will show a relatively large per cent. variation in the steam consumption. For this reason manufacturers guarantee an efficiency which is not quite so good as may be expected from the unit, or else guarantee the efficiency that may be expected, with an allowance to cover permissible inaccuracies in making tests.

Turning now to the measurement of the electrical output in connection with turbine tests, and considering first the measurement of direct-current output, station instruments provided in connection with the generator switchboard should not be used unless temperature conditions can be very accurately controlled and the instruments can be checked under operating conditions. Ordinary direct-current ammeters are especially liable to errors introduced by variations in room temperature. Precise measurement of direct-current output requires the use of portable indicating ammeters having, say, 200 millivolt drop shunts which permit the use of indicating millivoltmeters whose circuit consists largely of resistance material having practically no temperature co-efficient. When possible, also, it is desirable to measure volts by similar portable voltmeters. Especially if the instruments are not of the shielded type, they must be protected against the influence of stray fields. Further, care should be taken to correct the observed indications of the millivoltmeter for any electromotive forces that may appear in the shunt or leads due to thermo-electric effects. The amount of error due to this cause may be observed by reading the millivoltmeter at the close of the test with no current flowing in the main circuit, and a correction should be applied to the observed ampere readings.

The precautions which should be taken with direct-current instruments to eliminate disturbing influences are of even more importance in the measurement of alternating-current output. In the latter case also the current leads of the circuit under test may become a source of error. If the output is small, less than, say, thirty kilowatts, wattmeters, ammeters and voltmeters without current or volt multipliers may be used. While the station instruments and instrument transformers can be properly checked and employed for the precision test, it is usually more convenient to insert transformers specially tested for the work. In using instrument transformers it is necessary to observe the precaution to have the secondary connected load the same as that used in the standardization test. In tests under conditions that will give low power factor on circuits, it is necessary to make sure that the phase displacements in the instrument transformers are not large enough appreciably to affect the results. Further, it is well not to use instrument transformers with interconnected secondaries except for the common ground connection used for the sake of safety.

If possible, a test should be made on non-inductive load. In this case the indications of the voltmeters and ammeters may be used to check the indications of the wattmeters. If the test cannot be made at unity power factor, the voltmeters and ammeters should still be included so that the general conditions of load distribution, etc., may be known throughout the test. The use of watt-hour meters for this class of testing should be avoided wherever possible. The very best watt-hour meters that can be made are inferior in performance to the best portable indicating instruments. They should never be used unless checked in place at the frequency, voltage, wave shape, etc., which are to be used in testing. Checks of watt-hour meters should not, for precision purposes, be made with the meter subjected to other than exact load conditions and on the same circuit. If watt-hour meters are carefully tested in place and indicating instruments are employed and read at frequent intervals during a test run of three to five hours, the watt-hour record should agree with the output as determined by the indicating instruments within one per cent. on a fairly steady commercial load, with the chances largely in favor of the correctness of the indicating instruments. Single-phase indicating instruments for polyphase service are to be preferred for precision work to polyphase instruments. Single-phase instruments are required for determining the division of load between the two elements of polyphase instruments; since they are required for this purpose they may as well be of the precision class and used for the actual determinations.

THE DISPOSAL OF TRADE WASTES.

A STATEMENT OF THE PRINCIPLES GOVERNING THE DISCHARGE OF INDUSTRIAL WASTES INTO PUBLIC WATERWAYS AND SEWERS.

George A. Johnson—New Jersey Sanitary Association.

CONTAMINATION of the waters of streams and lakes by industrial wastes is in certain districts a problem of little less importance than the pollution caused by sewage. With the growth of large manufacturing centres it may be expected rapidly to increase in importance, and George A. Johnson has recently stated before the New Jersey Sanitary Association that the problem of trade-wastes disposal is becoming every day more difficult of entirely satisfactory solution. A large part of the difficulty, he says, is due to the practical impossibility of strictly interpreting the term "riparian rights." Riparian owners frequently claim an unqualified right to discharge trade wastes into a stream without any attempt at prior purification, a practice which may render the water unfit for use by individuals or communities farther down stream. Further, the granting of such a right may confer an unfair advantage over other manufacturers, not riparian owners, who are obliged to purify their wastes for discharge into public sewers. We are not concerned here, however, with the legal aspects of the problem but with the technical principles which should govern the discharge of industrial wastes into public waterways and sewers.

"The seriously complicating factor in the trade waste problem is the wide and sudden variation in the composition of the wastes, not only in different factories but in a single factory. It is impossible to lay down hard and fast rules to govern the degree to which all wastes must be purified before they are discharged, for the simple reason that each problem must be considered in the light of the surrounding conditions, and the remedial cloth cut to suit the local requirements.

"Probably the most important feature requiring consideration is the amount of solid matter which the wastes contain, expressed not in the terms of the analyst as so many parts per million but more comprehensively as tons per day or per year. It might almost be said that if all trade wastes were to be treated before their discharge to the extent of removing the suspended solid matters, the trade-waste problem would be nine-tenths solved. Of course there are cases where spent dyes, for example, would render a stream unfit for use by some industries, and where large volumes of antiseptics in a clarified waste liquor which was allowed to enter the public sewer system might seriously interfere with the treatment of the sewage at the purification works. But it nevertheless remains a fact that if such solids as dirt, hair, soap and grease, tar, wool, malt and solid refuse from breweries and distilleries, were first removed, the resulting liquor, in the vast majority of cases, would cause little if any trouble at the purification works; and except where the volume of such wastes is greatly out of proportion with the stream flow, the liquid wastes would speedily become purified and be practically unobjectionable.

"It is not possible or expedient to exclude from rivers the wastes of manufacturing industries. Some depreciation in the quality of the water in the stream is inevitable, but the use of moving bodies of water for trade-waste disposal should be permitted to the greatest practicable extent, so long as actual nuisance is avoided and the public health is not endangered. It is fortunate that in the large majority of manufacturing wastes the element of danger coming from the presence in such wastes of pathogenic germs is usually a minimum.

"Under practically all circumstances, the disposal of trade wastes means their discharge into the nearest waterway or into public sewer systems. In the latter case the question arises: To what degree must such liquors be purified before they may properly be admitted into the public sewers? As a rule this means the removal by the manufacturer of the suspended solid matters in the wastes. As already stated, these matters undoubtedly represent the greatest objection to the discharge of such wastes into public sewers or public waterways. There are cases, however, where certain germicides present in the wastes affect prejudicially the subsequent purification of the domestic sewage with which the wastes are mixed.

"Permission for the manufacturer to discharge his wastes into public sewers may be hedged in by a number of provisions which offer many opportunities for varied interpretation by the different parties interested. In general these are that the wastes shall not injure the sewer, that is, contain substances which will actually injure the structure; further, that the wastes shall not affect prejudicially the subsequent purification of the sewage, meaning by this that they shall not add abnormally to the solid content of the sewage, or to its content in grease, tar products, etc., or certain germicides which will destroy such bacterial life as is absolutely necessary for the proper and sufficient purification of the sewage by artificial methods; and finally, and perhaps most important of all, that the trade wastes shall not abnormally affect the capacity of the sewer.

"Taking these points up in order, it appears that little apprehension need be felt with respect to the possible effect which any trade waste may have upon the sewer itself, so far as causing actual damage to the structure. It is true there may be cases where the wastes are so strongly acid that there may be brought about a disintegration of the structure, but such cases are rare.

"The prejudicial effect which wastes may have upon the subsequent purification treatment is one which frequently requires some careful consideration, for the destruction of beneficial bacterial life precludes efficient purification by artificial methods. Wastes which contain arsenic, for instance, if such germicides are present in relatively large quantities, should be treated by the manufacturer before they are discharged into the sewer. A simple method of removing the arsenic is to pass the liquid through a layer of iron filings or coke. Speaking broadly, trade wastes and domestic sewage are probably best and most economically treated together. When the complete purification of wastes alone is attempted many complications arise, for it may perhaps be stated as a general proposition that trade wastes are not amenable to biological purification.

"Wastes which contain large quantities of solids like hair, lime, gas, tar, grease, distillery refuse and other similar wastes, should have such substances removed to the greatest practicable extent before the wastes are discharged into public sewers or into public waterways. Such solids, if allowed to enter the sewers with the liquid wastes, may produce clogging, and are almost certain to be a somewhat expensive proposition to remove at the purification works, especially if these works do not contain ample facilities for preliminary sedimentation.

"The question of when trade wastes may be admitted into public sewers is a serious and difficult one to discuss. In scattered urban and rural districts the volume of trade wastes is frequently so great as to upset the whole sewage system on account of the disproportion of the wastes to the sewage. It is a difficult problem to proportion the cost of a certain sewer to each user thereof. If the apportionment is on the basis of the actual volume of sewage which each user discharges into it, the manufacturer, who is usually the biggest taxpayer, is the hardest hit, and frequently will not only flatly refuse to pay such a proportion of the cost, but will even defend extended litigation in the courts intended to compel him to do so.

"To what extent, and under what restrictions, may public waterways be used for the reception of unpurified trade wastes? Obviously the public health must not be endangered; the flow in the stream must be sufficient at all times to disperse speedily and allow the purification of such wastes to a degree where public and industrial water supplies will not be affected prejudicially; and, finally, the wastes must not be of such a composition that they will form unsightly and otherwise objectionable sludge deposits in the bed or on the banks of the stream. To live up to all of these requirements, each problem must be considered by itself in the light of all the surrounding conditions. It is impossible to state a specific remedy to cover all cases."

MODERN GRINDING PRACTICE.

A SUMMARY OF RECENT IMPROVEMENTS IN MACHINERY AND METHODS FOR ORDINARY AND PRECISION GRINDING.

B. M. W. Hanson, W. A. Viall—American Society of Mechanical Engineers.

LAST month we reviewed in these columns the first of three papers on grinding read at the recent annual meeting of the American Society of Mechanical Engineers. C. H. Norton, the author of the paper in question, introduced the subject by a discussion of the field for grinding in machine-shop practice; our review gave an extended abstract of his exposition of the economy of grinding in comparison with the removal of metal by turning or milling in certain classes of work. The other two papers, abstracted at length below, dealt with recent improvements in machinery and practice for ordinary and precision grinding.

Modern grinding methods are summarized in the paper by B. M. W. Hanson. "The designers of grinding machinery," he says, "have had a good many problems to solve. Different materials require different speeds and on the modern grinding machine there must be various speeds for the grinding member as well as for the traverse movement of the work; and for the revolution of the work in the case of the cylindrical grinder. Machines must be designed with water pumps, and the working parts must be protected from water as well as from the grit which comes from the grinding wheel. The grinding member usually moves at a high rate of speed and must have carefully designed bearings which will run freely, yet not allow any back lash, as true surfaces can only be obtained when the work and the reducing member move against each other in fixed positions.

"The grinding machines now used can be divided into two large groups; machines for cylindrical grinding and machines for grinding flat surfaces. Cylindrical grinders are well known and have been highly developed by four machine-tool builders in this country. The other style of grinder, the surface grinder, is best known as a planer type machine, with a wheel grinding on its periphery, and fed across the surface in much the same manner as a tool is fed across the surface on a planer or shaper. Another type is the vertical surface grinder with a cup-shaped wheel working in much the same manner as an end mill on a vertical milling machine.

"In doing work on lathes or milling machines, it is comparatively easy to reproduce several pieces to the same dimensions by adjusting the machine to a size. This is possible because the reducing member, which is the turning tool, will resist wear for a considerable length of time without making any difference in the size of the work. With grinding machinery this is more difficult since the reducing member is constantly wearing away at a rapid rate. For very close work it is necessary to readjust the machine for every piece to be ground, which of course requires skill and time on the part of the operator."

Mr. Hanson describes a recent device for controlling the size of the work, no matter how much the reducing member wears away. The feed of the reducing member is controlled electrically; when the work has reached the desired size, which can be predetermined by suitable adjustments, the machine will automatically throw out the feed. With this machine any number of pieces can be ground to practically the same diameter, say within one-quarter of a thousandth of an inch. An operator can manipulate more than one of these machines, and he requires comparatively little skill to get uniformity of size. Another device described by Mr. Hanson is a back rest which automatically advances at exactly the same rate that the diameter of the work is reduced.

TABLE I. GRINDING LIMITS FOR CYLINDRICAL PIECES

AS ADOPTED BY BROWN & SHARPE MFG. CO.*

Diameter.		
RUNNING FITS—ORDINARY SPEED.		
To ½-in., inc.	0.00025 to 0.00075	Small
To 1 -in., inc.	0.00075 to 0.0015	Small
To 2 -in., inc.	0.0015 to 0.0025	Small
To 3½-in., inc.	0.0025 to 0.0035	Small
To 6 -in., inc.	0.0035 to 0.005	Small
RUNNING FITS—HIGH SPEED, HEAVY PRESSURE AND ROCKER SHAFT.		
To ½-in., inc.	0.0005 to 0.001	Small
To 1 -in., inc.	0.001 to 0.002	Small
To 2 -in., inc.	0.002 to 0.003	Small
To 3½-in., inc.	0.003 to 0.0045	Small
To 6 -in., inc.	0.0045 to 0.0065	Small
SLIDING FITS.		
To ½-in., inc.	0.00025 to 0.0005	Small
To 1 -in., inc.	0.0005 to 0.001	Small
To 2 -in., inc.	0.001 to 0.002	Small
To 3½-in., inc.	0.002 to 0.0035	Small
To 6 -in., inc.	0.003 to 0.005	Small
STANDARD FITS.		
To ½-in., inc.	Standard to 0.00025	Small
To 1 -in., inc.	Standard to 0.0005	Small
To 2 -in., inc.	Standard to 0.001	Small
To 3½-in., inc.	Standard to 0.0015	Small
To 6 -in., inc.	Standard to 0.002	Small
DRIVING FITS—FOR SUCH PIECES AS ARE REQUIRED TO BE READILY TAKEN APART.		
To ½-in., inc.	Standard to 0.00025	Large
To 1 -in., inc.	0.00025 to 0.0005	Large
To 2 -in., inc.	0.0005 to 0.00075	Large
To 3½-in., inc.	0.00075 to 0.001	Large
To 6 -in., inc.	0.001 to 0.0015	Large
DRIVING FITS.		
To ½-in., inc.	0.0005 to 0.001	Large
To 1 -in., inc.	0.001 to 0.002	Large
To 2 -in., inc.	0.002 to 0.003	Large
To 3½-in., inc.	0.003 to 0.004	Large
To 6 -in., inc.	0.004 to 0.005	Large
FORCING FITS.		
To ½-in., inc.	0.00075 to 0.0015	Large
To 1 -in., inc.	0.0015 to 0.0025	Large
To 2 -in., inc.	0.0025 to 0.004	Large
To 3½-in., inc.	0.004 to 0.006	Large
To 6 -in., inc.	0.006 to 0.009	Large
SHRINKING FITS—FOR PIECES TO TAKE HARDENED SHELLS ⅜-IN. THICK AND LESS.		
To ½-in., inc.	0.00025 to 0.0005	Large
To 1 -in., inc.	0.0005 to 0.001	Large
To 2 -in., inc.	0.001 to 0.0015	Large
To 3½-in., inc.	0.0015 to 0.002	Large
To 6 -in., inc.	0.002 to 0.003	Large
SHRINKING FITS FOR PIECES TO TAKE SHELLS, ETC., HAVING A THICKNESS OF MORE THAN ⅜-IN.		
To ½-in., inc.	0.0005 to 0.001	Large
To 1 -in., inc.	0.001 to 0.0025	Large
To 2 -in., inc.	0.0025 to 0.0035	Large
To 3½-in., inc.	0.0035 to 0.005	Large
To 6 -in., inc.	0.005 to 0.007	Large
GRINDING LIMITS FOR HOLES.		
To ½-in., inc.	Standard to 0.0005	Large
To 1 -in., inc.	Standard to 0.00075	Large
To 2 -in., inc.	Standard to 0.001	Large
To 3½-in., inc.	Standard to 0.0015	Large
To 6 -in., inc.	Standard to 0.002	Large
To 12 -in., inc.	Standard to 0.0025	Large

* The limits given in the table can be recommended for use in the manufacture of machine parts to produce satisfactory commercial work. These limits should be followed under ordinary conditions. Special cases should always be considered, as it may be desirable to vary slightly from the tables.

"Surface grinders have usually been made with the wheel grinding on its periphery and in some instances it may be necessary to continue to do work on this principle, as grooves and irregular shapes sometimes have to be ground and the thinness of the wheel makes it possible to get into narrow places; but when flat surfaces are wanted, the cup-shaped wheel has taken a foremost place in grinding. The wheel covers the whole width of the work at once and water is forced through the center of the spindle, centrifugal force throwing the water outward and compelling it to pass between the work and the wheel. It is astonishing with what rapidity work can be reduced to a flat surface under this process.

"This method of grinding would never have been successful if it had not been for the advancement in wheel making. The wheel problem in connection with the machine has been most difficult. It has been found very essential to select the right kind of wheel for different classes of work and for different materials. For grinding steel, either hardened or soft, corundum wheels have proved the best and for grinding cast iron the carborundum wheel has proved the best. The different degrees of hardness must be taken into consideration when the width of the surfaces to be ground varies."

The latest type of this machine has a table stroke of 6 feet, and can grind a piece 6 feet long and about 25 inches wide, and circular ring or disk surfaces up to 30 inches in diameter. Mr. Hanson gives the following comparison of the capacity of a grinding machine having a cupped wheel for grinding flat surfaces with a machine having a wheel grinding on its periphery and working on the principle of a planer:

"The traversing speed of the work or the work table can be assumed to be the same. If a piece is 6 inches long and 3 inches wide, the machine grinding on its periphery will take about 48 strokes to cover the surface, assuming 1/16 inch feed for each stroke. The cupped-wheel machine will do the same amount of work with one stroke or in about 1/24 the time. These proportions are essentially true on hardened steel or on any kind of work where a nice finish is required."

W. A. Viall dealt with the subject of precision grinding. "The principles of grinding, in the main, are not difficult to grasp, and the time that would be required of the ordinary chief operator in grasping them is not excessive. But the work does require such attention and knowledge of the results that can be obtained, coupled with the skill acquired by experience, as to class it with the arts. In the early days it seemed quite necessary that for every different piece of work we should have a different wheel. Later it was found that a given wheel would give satisfactory results on various kinds of work by varying the speed of the wheel, the speed at which the work was run, or the feed of the work, so that one wheel answered a great variety of purposes. There have been changes in abrasives and we are getting to-day a far better quality of wheel than was possible some years ago. The grading of wheels has very much improved, and although in the writer's opinion it is not possible to obtain an absolute grading, this element has been reduced to such a nicety that it need not be taken largely into account by the average operator.

"The first use of the grinding machine as we know it to-day was to correct slight errors that were impossible of eradication by means of the file and emery cloth. To-day the grinding machine rectifies these errors and in addition finishes work for appearance and fit in a relatively cheap manner. After the proper machine has been selected, the choice of wheels requires some specialized knowledge which the makers of machines and wheels are in a position to furnish to an extent that many of the users of machine tools are probably not aware. When the proper wheels and gradings are once established for a given line of work, their subsequent use is very easy.

"The question of speeds and feeds is also the result of experience, and suggestions from the manufacturers will help users to a great extent in obtaining

TABLE 2. LIMIT GAUGES FOR LATHE WORK.

Size.	Not Go On.	Go On.	Size.	Not Go On.	Go On.	Size.	Not Go On.	Go On.
	Inches.			Inches.			Inches.	
⅜	0.383	0.387	15-16	0.9455	0.9495	1½	1.508	1.512
7-16	0.4455	0.4495	1	1.008	1.012	1 9-16	1.5705	1.5745
½	0.508	0.512	1 1-16	1.0705	1.0745	1⅝	1.633	1.637
9-16	0.5705	0.5745	1⅛	1.133	1.137	1 11-16	1.6955	1.6995
⅝	0.633	0.637	1 3-16	1.1955	1.1995	1¾	1.758	1.762
11-16	0.6955	0.6995	1¼	1.258	1.262	1 13-16	1.8205	1.8245
¾	0.758	0.762	1 5-16	1.3205	1.3245	1⅞	1.883	1.887
13-16	0.8205	0.8245	1⅜	1.383	1.387	1 15-16	1.9455	1.9495
⅞	0.883	0.887	1 7-16	1.4455	1.4495	2	2.008	2.012

satisfactory results. It is only under proper conditions, however, that these results can be obtained. The wheels must be true and they must not be forced into the work to too great an extent, for this produces a torn effect on the work.

"In considering a piece of work to be done, first of all the question arises as to the size and limits suitable for the purpose for which it is intended. Table 1 gives the limits used at the Brown & Sharpe Company's works for varying conditions. There are special cases where it may be necessary to alter these limits, and this table is not offered as the final word but as a guide towards selection.

"The second necessity is that sizes should be established to which the work should be rough turned ready for the grinding room. In the Brown & Sharpe works, as in all factories, the aim is to produce the desired results as cheaply as possible. The desired ends have been accuracy and nicety of finish where the parts ground are for fits, and nicety of finish where no fits are required. To do this work as cheaply as possible we believe that it is economical to turn the pieces to about the sizes indicated in Table 2. It will be noted that we allow from 0.008 inch to 0.012 inch in diameter, an amount easily obtained by the ordinary class of lathe help. In order to make this work as easy as possible for the lathe department we furnish limit gauges. We are aware that practice varies on this point, and we have thoroughly endeavored to try out the plan of allowing correct limits, but we have found it fully practicable to hold the lathe to the limits given. By so doing we obtain the finished product free from all tool marks and at what we believe is the minimum cost."

THE PLAN FOR RAISING THE WRECK OF THE "MAINE."

A CRITICAL DISCUSSION OF THE ARMY ENGINEERS' PLAN FOR RAISING THE WRECK OF THE "MAINE"; THE DESIGN OF COFFERDAMS FOR VERY DEEP WATER.

Engineering News.

PROBABLY no engineering work ever undertaken by the United Government has aroused the sentimental interest of the American people to the same extent as the raising of the wreck of the battleship "Maine" which was sunk in Havana harbor in 1898. Sentimental considerations have governed the decision to raise the wreck instead of removing the obstruction to navigation by blowing it to pieces and dredging out the wreckage. The recovery of the bodies of the sailors who lost their lives in the explosion which wrecked the "Maine" is the main object of the costly work of raising the vessel intact. The plan adopted by the army engineers, however, has much more than a sentimental interest, although its adoption was governed wholly by sentimental motives. The plan involves a long step forward in the design and construction of cofferdams in very deep water and on a very soft bottom; for this reason it merits the close study of engineers. The problem is very clearly put in an editorial discussion of the project in *Engineering News* for December 29, 1910, which we abstract at length.

"The problem is to surround the wreck of the vessel, about 325 feet in length, lying in 37 feet depth of water, with a dam which shall be tight enough and strong enough to enable work to be safely carried on under its protection. This dam must be self-sustaining. There is no way of bracing it to resist the water pressure behind it by struts against its interior. The borings show that for a depth of 18 to 20 feet the bottom of the harbor is a soft semi-liquid mud. Below that for some 25 to 30 feet there is a soft blue clay. The building of a dam which will withstand a head of 37 feet of water on such a foundation is a task so unprecedented that it may well excite the interest of engineers generally. The dam must not only be self-supporting and safe against the pressures to which it is exposed, but it must be capable of complete removal after it has served its purpose. It must, moreover, be able to support more or less superposed loads. Upon it must be built some sort of working platform from which can be carried on the work of unwatering the area which it encloses and from which afterwards men and materials can be transferred to the interior for work upon the wreck.

"The plan which the Board of Army Engineers has adopted is to sink around the wreck a series of large cylinders of interlocking steel sheet-piling. These cylinders are to be 50 feet in diameter along the sides of the wreck and 40 feet at the bow and stern. The sheet-pile cylinders are to be sunk to a depth of 70 feet from the surface, which means that their lower ends will have about 33 feet penetration in the bottom. After these cylinders have been sunk, a dredge will dig clay from shoals in the harbor and deposit it in hopper scows. These scows will be towed over to the cofferdam, and their loads of clay will be deposited in the cylinders until they are full.

"Consider, first, the stresses that exist after the cylinders are filled with clay and before the area enclosed by the dam is laid dry. Each cylinder may be compared to a grain-bin or a standpipe, and we may proceed to compute the bursting pressure due to the weight of the soft clay tending to open the cylinder at the joints between any two of the interlocking piles. Under the circumstances in which it is placed it seems certain that the clay will be so soft and will flow so readily that it will act very much like a liquid in producing horizontal pressure. After considering the formulae in common use for pressures on grain-bins and on ordinary retaining walls, it seems to us that under the conditions existing in these cylinders at Havana it will not be safe to assume a pressure due to the contained mud in these 50-foot cylinders of less than 80 per cent of the full pressure which would exist if the mud were a perfect liquid.

"The saturated clay with which the cylinders are to be filled weighs about 120 pounds per cubic foot. At the harbor bottom, in 37 feet of water therefore, the pressure per square foot against the side of the cylinder will be 120 pounds × 37 × 80 per cent = 3,552 pounds. The seawater surrounding the cylinder, however, weighing 64 pounds per cubic foot, exerts its full liquid pressure, in opposition to the internal pressure of the clay. This water pressure at the harbor bottom is 64 pounds × 37 = 2,368 pounds per square foot. Subtracting this from the internal pressure due to the clay filling we obtain 1,184 pounds per square foot as the net internal pressure upon the cylinder at the harbor bottom. On the cylinder 50 feet in diameter this internal pressure will cause a tangential stress of 1,184 pounds × 50 ÷ 2 = 29,600 pounds per lineal foot of joint, or 2,460 pounds per lineal inch.

"The Lackawanna steel sheet piling which is being used at Havana, has joints with an ultimate tensile strength, we understand, of about 10,000 pounds per lineal inch. The sheet-pile cylinders, therefore, are apparently strong enough to hold their clay filling until the cofferdam is completed and the process of unwatering begins.

"Let us now consider the stresses after the interior of the cofferdam is pumped out. The interior bursting pressure due to the clay filling remains the same, and the external water pressure is the same on the side of the cylinder next the sea. On the inner side of the cofferdam, however, the water pressure is removed and there is, therefore, a maximum bursting pressure at the bottom of the cofferdam cylinders on the inner side amounting to 3,552 pounds per square foot. This pressure produces a tangential stress on the joints of the steel piling equal to 88,800 pounds per lineal foot of joint, or 7,400 pounds per lineal inch. As the ultimate strength of this joint is only assumed at 10,000 pounds per lineal inch it will be at once evident that the stress contemplated in the design is much too high for safety.

"Further, there may be stresses on this joint from other causes than internal pressure of the clay filling. Loads on the top of the pile cylinder due to the working platforms and anything placed upon them will be carried by the piles as long columns and the tendency of the piles to bow outward when so loaded will produce stress upon the joint. Again, the piles cannot be driven exactly vertical. If the foot of a pile inclines slightly inward as it goes down, the joint between it and the piles on either side will be under compression. If the foot of the pile inclines slightly outward, the joint will be under an initial tension before the filling of the cylinder with clay begins. This initial tension must be added to that caused by the pressure of the clay filling to obtain the total stress upon the joint. . . .

"Let us inquire now concerning the strength of the cylinder as a whole to resist the horizontal pressure of the water on the outside of the cofferdam after the interior is pumped out. The computation of the water pressure is, of course, exceedingly simple. The 50-foot diameter cylinder in water 37 feet deep has an area of 50 × 37 = 1,850 square feet. The pressure varies from zero at the surface to 2,368 pounds per square foot at the base. Thus the average pressure on the cylinder is 1,184 pounds per square foot, and the total pressure is 2,190,400 pounds, or 1,095 tons, which may be considered as concentrated at a point two-thirds the distance below the surface, or 12 feet from the bottom. The average overturning pressure per lineal foot of the whole cofferdam is about 25 tons.

"What is the strength, now, of the mud-filled steel-pile cylinders to resist this huge horizontal pressure? The empty sheet-pile cylinder itself, manifestly, could not begin to sustain it. The piles would bend over in the soft mud into which they are driven, sliding upon each other at the joints like the staves of a barrel with loose hoops. The interior filling, however, by placing the joints under tension, adds greatly to the strength of the cylinder and in addition has a large resistance of its own. What that resistance is, it is impossible to compute. It depends upon the consistency of the material, and its internal friction. If good gravel were available for filling the cylinders, for example, their strength would almost certainly be ample. On the other hand, if the clay with which the cylinders are filled is slow to give up its water and remains a soft, putty-like, greasy mass, it seems likely that the clay may slowly flow under this heavy pressure and the cylinder may be pushed over until the distortion added to the internal bursting stress will open some joint, allow the clay to flow out and the dam to fall.

"For it must be clear that the opening of any one joint of all the thousands in these steel-pile cylinders will mean the immediate failure of a cylinder and the flooding of the interior of the cofferdam. The clay filling of the cylinders will flow if released, we should judge, at least as readily as grain in an elevator bin; and besides if any joint fails, the pressure will quickly open out the sides of the cylinder to right and left on either side of the break, giving a wide opening for the outflow of the clay. Further, when the clay flows out of the cylinder, the exterior wall against which the water stands will be left unsupported and liable to collapse as soon as the clay is removed to great enough depth."

As a means of increasing the strength and safety of the design now adopted, the engineers in charge contemplate hooping the steel cylinders near the bottom, where the bursting pressure is greatest. Despite the enormous difficulties it might be possible of accomplishment, but even if the hooping were successfully done, from the bottom up to a depth of 20 feet or so, where the strength of the unhooped joint might be assumed to be sufficient, it would leave the strength of the mud-filled cylinders to resist the horizontal water pressure still uncertain.

As an alternative to this plan, *Engineering News* suggests the dumping of a mound of coarse gravel or riprap stone along the inner side of these cylinders. Such a mound of stone, particularly if it were of high specific gravity, would exert a heavy counter-pressure to resist both the interior pressure of the clay and the horizontal pressure of the water outside. It would take a large amount of stone, but it could be placed and removed at a low cost per cubic yard, and the total cost would not be a prohibitive percentage of the entire cost of the work.

THE BUILDING OF THE NEW CANADIAN NAVY.

THE PROBABLE CHOICE OF VANCOUVER AS THE LOCATION OF THE NAVY YARD FOR THE CONSTRUCTION OF THE PROPOSED VESSELS.

The Engineer.

ANNOUNCEMENT has been made from Ottawa that contracts for the proposed ships to form the nucleus of a Canadian navy will be let by the Dominion Government in the near future. It is reported that six British shipbuilding firms have been invited to tender for the construction of four cruisers, presumably of the *Bristol* type, and six destroyers, and some Canadian firms also have offered to undertake the work. All of the vessels are required to be built in Canada, and for this reason the contracts for the whole ten will be let to a single contractor. Canada has at present no shipbuilding establishment capable of undertaking a work of this magnitude, and the building of the new navy will involve the establishment of a navy yard of considerable extent.

The probable location of this yard is discussed in *The Engineer* for December 23, 1910. It is reported that "already there are rumors that point to Vancouver, on the Pacific coast, as destined to be the favored locality. It is situated on the finest natural harbor of Canada, and the construction of a large dry dock is to be immediately proceeded with there. Proposals are also on foot for building a floating dock capable of lifting ships of 15,000 tons displacement.

"The Pacific coast offers very many attractions to a shipbuilder. Its harbors are as fine as any on the Atlantic coast, and facilities for obtaining material are good. Coal and iron are obtainable at the very door, and if requisite capital to erect adequate smelting works and rolling mills were forthcoming, the business of steel shipbuilding, which has already reached respectable growth, would receive a tremendous incentive. If it be true that the new Canadian navy is to be built at this port its future as a shipbuilding centre is assured. The coasting trade alone provides a considerable amount of repair work, much of which is at present diverted to other ports from lack of docking accommodation. Such firms as Harland and Wolff, Swan, Hunter, and Wigham Richardson, and others have had representatives on the spot making investigations as to the possibilities of development along these lines.

"Vancouver has one decided advantage over Atlantic ports in its Pacific slope climate, which would render the business of shipbuilding possible all the year round. Burrard Inlet, upon which it stands, seems to possess all the requirements which appeal to the professional and business instincts of the shipbuilder. It is an ideal site for the purpose. The harbor is magnificent, being land-locked, and therefore quite sheltered. Within the First Narrows, known as the Lion's Gate, the shore of the harbor proper, not including the north arm of Burrard Inlet, extends 25 miles, while the width is 2¼ miles. The low-water depth at the wharves is 26 feet, and in the stream about 30 fathoms. The avearge rise and fall of tide is 13½ feet. At low tide the present entrance to the harbor has a width of 700 feet at its narrowest point. It is, however, to be widened to 1,200 feet, and dredged to a uniform depth of 30 feet to 35 feet at dead low water. A contract has been placed by the Dominion Government for a special dredger to do this work which will be completed, it is estimated, in about three years, including the removal of some shoals and a projecting reef. At the wharves of the shipbuilding business at present in operation there is a depth of 30 feet of water at low tide, so that war vessels could be afloat at all times.

"Burrard Inlet, then, needs little artificial improvement to make it suitable as a shipbuilding centre, whether for warships or merchant vessels, and it is likely to be a strong, if not the strongest, competitor for the construction of the new Canadian navy. Indeed, the site at North Vancouver, upon which large shipyards are to be erected in the near or more distant future, is practically settled; it is on the north shore of the inlet, where there is plenty of deep water close in shore. The Imperial Dry Dock and Shipbuilding Company has been granted a subsidy from the Dominion Government, and Roche Point has been selected as the site of a new dock. Victoria, 84 miles from Vancouver, has at present the lead in shipbuilding when compared with Vancouver, and has turned out such vessels as the *Princess Royal and Princess Beatrice* for the C. P. R. line. Notwithstanding this, Vancouver appears from its natural suitability for the purpose destined to become the largest shipbuilding and commercial centre on that part of the Pacific coast. It possesses, with the minimum of expenditure a harbor such as many seaports cannot secure at any price. The only shipbuilding now carried on there of any importance is on quite a small scale, but it is up to date so far as its has gone, and although the larger of the two firms employs less than a hundred hands, and it is of quite recent establishment, it is intended to be the nucleus of a much larger concern.

"There are large coal deposits in the immediate neighborhood; a new mining corporation called the Canadian Collieries Company has recently acquired an immense coalfield on Vancouver Island, and has devoted three million dollars to opening up and developing of new mines on their property, and to increasing the output of those already in operation. Mechanical haulage, by means of electric power, generated by a 50,000 horsepower waterfall will be installed, and this source of power will at the same time supply other affiliated businesses.

"It is a trite saying, that progress of trade in a seaport is infallibly indicated by the appearance of the wharves on the water front, and this port is no exception. Her rapidly extending wharfage is generally in a more or less congested condition. In the Vancouver service, Messrs. Alfred Holt & Co., of the Blue Funnel line, as it is termed, maintain a fleet of eight fine vessels. The C. P. R. steamers, and the Andrew Weir line, both run constantly between Vancouver and the Orient. The Canadian-Australian mail service to Sydney is carried on by the Union Steamship Company of New Zealand, and a large cargo business is done with goods from the Atlantic coast and Europe, which are transported across the Isthmus of Tehuantepec by the railway from Puerto-Mexico, to Salina Cruz, and thence re-shipped to ports on the Pacific coast. This latter route is so much cheaper than the trans-continental railway freight, that a consignment of goods from, say, Montreal to Vancouver would be carried via the Isthmus for little more than half the overland railway freight across the Continent.

"Five years, or even three years ago, export of Canadian grain from Vancouver was a dream only entertained by one or two far-seeing and optimistic individuals. About two years ago the probability of Vancouver becoming a great factor in the shipment of grain from Alberta and Saskatchewan began to attract attention, and to-day she is a grain-exporting centre whose output is only limited by the present dimensions of the demand for Alberta wheat. When the

Panama Canal is opened there will probably be a great deflection of the present eastward flux of wheat from Alberta, Saskatchewan, and Manitoba to the western route via Vancouver, with a very considerable saving of time as compared with the lake route. Vancouver harbor is open and free from ice all the year round, and great things are expected of the A. B. C. route—Alberta British Columbia—as a great exporting channel for Canadian grain.

"The growth of the railway systems of British Columbia is commensurate with expansions apparent in other directions, and Vancouver is fast becoming one of the biggest railway centres on the Pacific coast. The question is, will its natural advantages cause it to become the chief seaport of that coast? Basing judgment on its geographical and terminal position, it appears probable that it will. For nearly twenty years the C. P. R. was the only railway entering the city. The Great Northern and the Northern Pacific came later, giving an example likely to be soon followed by others. Three years will see the Canadian Northern connection complete with the East. The Grand Trunk Pacific has engineering parties in the field, with Vancouver as the main objective, and its line will probably be completed within five years. Other subordinate lines are also in construction.

"All this goes to show that the Dominion Government have every reason to favor Vancouver as a likely position for building and equipping their new navy. By the time the first instalment of it is in being, there will be a valuable national asset to protect there, and one can easily imagine how strong an appeal such a natural harbor as Burrard Inlet must make to both the technical and strategical components of the Dominion Government."

COKE IN FOUNDRY PRACTICE.

THE IMPORTANCE OF ADJUSTING CUPOLA PRACTICE TO SUIT THE CHARACTERISTICS OF THE FUEL USED.

Richard Moldenke—United States Bureau of Mines.

THE coke industry of the United States as related to the foundry is the subject of a monograph prepared by Dr. Richard Moldenke for the United States Bureau of Mines, and recently published as Bulletin 3 of the Bureau's publications. The bulletin reviews, with Dr. Moldenke's well known lucidity, the status of the coke industry, some features of practice in the use of coke in the foundry, the probable happenings of a cupola heat, and the reasons for modifying charging practice so that a particular coke can be used to the best advantage. It is to the last of these topics that attention is directed in the following paragraphs. Dr. Moldenke believes that the many troubles laid to the idiosyncracy of the cupola could really be avoided by changing the melting programme to suit the fuel used.

"Normal coke has 50 per cent. cell space and has, pound for pound, practically double the volume of anthracite. Hence during the melt the downward movement of the metal within the range of the melting zone must be twice as fast when coke is used as it is with anthracite. Therefore the difference between the first of the metal to melt and the last, with respect to the influences to which they have been exposed, is greater for a bed of coke as compared with a bed of anthracite of like weight. That is, the first metal to melt is likely to be the same on either the coke bed or the bed of anthracite, but the last metal, especially if the charge is very heavy, melts much lower down in the coke-charged cupola and is necessarily subjected to greater oxidizing influences, because the blast low down in the cupola contains more free oxygen. When anthracite is used the part of the bed where the melting is actually done varies least in position. This advantage is still retained by many foundry men in the East, where anthracite, as it is still available and no dearer than coke, may be used for the fuel bed and often mixed with coke in the subsequent charges, or even used altogether.

"A study of the downward movement of the metal, as just stated, is important, as it suggests the way to make use, in regular casting practice, of practically every variety worthy of the name of foundry coke. Anthracite and coke, being practically identical in composition—that is, containing the same percentage of ash, fixed carbon, sulphur, etc.—differ radically only in physical structure. Thus, if the cell space of a coke is 50 per cent., as mentioned above, the coke has twice the volume of an equal weight of anthracite. Now, not all cokes have the same cell space, and, moreover, cokes differ in percentage of ash, etc. Hence a given weight of coke varies greatly in volume, and consequently the behavior of charges of iron melted with it also varies. The foundryman when changing his brand of coke makes the mistake of believing that the new kind ought to be handled in the same way as the old. It may be possible to do so if the two cokes have the same characteristics, but if they have not the foundryman is certain to get differences in results, which he usually ascribes to sulphur, high volatile, black ends, and what not. His coke dealer then hears from him. This difficulty is so marked that even when the same brand of coke is bought the year round and trouble results, investigation of the shipments often reveals substitution of coke from different companies located in the same general region. Furnaces have this difficulty to contend with more particularly. It is therefore highly important that the foundry man get his coke from the same ovens and the same coal mines—in fact, have it as nearly the same as it can possibly be made; if a change is desirable or necessary he should be informed, so that he can adjust his work to the changed conditions.

"In this respect the retort-oven coke has a great advantage. After the coals have been contracted for and the proper mixture has been established, the result will continue to be even as long as the coking process is carried out uniformly; and as the highest scientific skill is available at retort ovens, there should be little variation from the standard if the management honestly wishes none. Another advantage of retort-oven coke is the size and shape of the lumps. A retort oven is narrow, and the coking of a charge proceeds from the walls toward the middle; the result is a mass of coke that, when quenched, breaks into short, thick pieces. The absence of thin fingers is decidedly noticeable. In comparison, the lumps of standard grades of beehive-oven coke are generally longer and thinner. Moreover, makers of retort-oven coke have carefully sorted the product before shipment, so that it has contained little breeze and the lumps have been of good shape. The size of the lumps of fuel in a cupola charge has much to do with the progress of the heat, and the absence of thin fingers accounts in a measure for the remarkable success of retort-oven coke when it was first used in foundries. Charges of coke having lumps that are uniform in shape and size give results similar to those obtained by using anthracite, which is marketed in screened sizes, because the uniform sizing of the fuel permits an even and regular penetration of the bed by the blast.

"In order to adjust the process to the varying character of the coke used for melting in the cupola, it is necessary not only to change the melting conditions, for instance, by using a milder or stronger blast according as the coke is light or heavy, but also to change the relative weight of the metal and coke charges on the bed. A foundryman using heavy charges, though he may not know why, avoids coke with a large percentage of volatile matter. Such coke is necessarily underburned and light and ignites rapidly, spreading the melting through too large a volume. Very light charges will obviate much of this trouble, as the bed of coke will be kept more nearly uniform in height, and the melting will be done at the proper point. A coke in which the volatile matter is too high is virtually a gas coke and is too troublesome for use in the foundry, at least for cupola melting. It will serve well enough for all other purposes.

"Coke producers should be urged to make thorough melting tests with their coke, so that when selling it they can advise foundry men how to get the best results with it. This plan would save enormous trouble, as there are about 6,500 foundries using coke in the United States and Canada, and but a very small percentage know how to make comparative tests of coke and draw conclusions therefrom that will guide them in its proper use. There are, on the other hand, comparatively few coke producers, or selling agents for coke producers, and it would pay these firms well to have a central testing station, or a sort of 'trouble bureau,' for coke tests. . . .

"As retort-oven coke, it is to be hoped, will be the foundry fuel of the future, the coke makers, by careful study of details, will probably bring about a very uniform product, with so slight variations in composition and physical structure that it will give uniform satisfaction to the user. In the meantime, however, we have to do with existing conditions. We have coke with low and with high sulphur, coke with low and with high ash, and occasionally coke so soft as to be very near the danger limit. By the very nature of the process of making it coke can not be uniform in structure, and only careful selection from the ovens as they are discharged gives the foundry man what he is paying for. In brisk times this selection is likely to be made less conscientiously, coke forks being discarded or their prongs made closer. Many coke tests have shown conclusively that much can be done to improve a coke by adapting the process of making it to the requirements."

THE OVER-RUNNING OF DANGER SIGNALS.

A BRIEF REVIEW OF GERMAN TRIALS OF DEVICES FOR THE PREVENTION OF OVER-RUNNING OF SIGNALS SET AT "DANGER."

M. Hoogen-Zeitung des Vereins Deutscher Eisenbahnverwaltungen.

EVERY railway accident directly attributable to the over-running of signals set at "danger" renews criticism of the railways for not employing some device for automatically stopping a train which runs past a danger signal. The recent South Orange derailment on the Delaware, Lackawanna & Western R. R. is a case in point. The question has been again raised in the technical press, and the critics of the railroads take the familiar attitude that the prevention of over-running by connecting some automatic-stop device with the danger signal would be a matter of little difficulty. This attitude, however, is not justified by the results of trials of such appliances in the United States and Europe. At the end of three years' work, the American Block Signal and Train Control Board have failed to discover any automatic stop which has, on the whole, seemed to promise an actual gain in railway safety. Their experience has only repeated that of the German railways which have experimented with these apparatus. This is clearly shown in a paper on the results of the German tests, contributed by M. Hoogen to a recent number of the *Zeitung des Vereins Deutscher Eisenbahnverwaltung,* reprinted in the *Bulletin of the International Railway Congress* for November, 1910.

At the request of the Austrian Railway Ministry, the question was taken up by the German *Verein* in 1902. The sub-committee of the *Verein* to which the investigation was referred reported that devices for informing the driver that a signal is at "danger" by means other than those already in use (for example, audible or other signals on the locomotive) were considered advisable, but that such devices should satisfy the condition of being absolutely reliable in their working. No devices fulfilling this condition had been submitted to the committee. Devices for automatically applying the brakes or cutting off steam without the intervention of the driver were reported to be inadvisable.

In adopting this report of the subcommittee in 1904, the technical committee of the *Verein* specified eight conditions which should be satisfied before a device could be considered absolutely reliable:

(1) The device must not only show that the corresponding stationary signal is being approached, and its eventual position at "danger," but also any defects in the device which would prevent its proper action.

(2) As far as stationary signals are concerned, the device must act soon enough to make it possible to stop the train with certainty before reaching the signal in question.

(3) The perception of the signal must not necessitate any previous attention on the part of the driver; on the contrary, the presence of the signal must at once make itself apparent to the driver in an unambiguous way, under all the conditions which may arise on a locomotive. The indication must be given whether the locomotive is running stack first or tender first.

(4) The device may only stop acting if the locomotive is standing still. Any switches are admissible only if they are so constructed that the locomotive cannot be started unless they are in the correct position.

(5) The device must be arranged so that its action cannot be stopped maliciously or unintentionally. The sign must not be given unintentionally by any obstructions on the track, which do not affect the running of the trains.

(6) Unauthorized persons should not be able to put a signal on or to pull it off.

(7) The upkeep and supervision of the device must not be attended with any particular difficulty.

(8) It must be possible to give the stop signal on the locomotive, without any particular difficulty or lengthy preparation, at each of the places so equipped, from any point that may be convenient.

It was not until the end of 1906 that devices sufficiently developed to warrant trial in ordinary working were submitted to the *Verein*. Systematic trials were undertaken by the Prussian State Railways, and of these the trials of double-light distant signals have resulted in the substitution of this type of distant signal for the type formerly used. The results have proved beyond doubt that the visibility of the distant signal in the night time is materially improved by the double-light arrangement. It is probable that an effective distant signal will for a long time to come remain the most effective means for preventing the overrunning of the main signal. Hence it may also be expected that the improvement of the distant signal will make it easier to attend to the stop signals.

In the experiments with combined detonating and visible signals it has been found that the detonation and light produced by the detonators used suffice to attract the attention of the driver. The care of the signals is a simple matter. The cartridges, usually three in number, are placed on the rail by a lever mechanism operated from the signal cabin. The introduction of this machine into the signal circuit, however, caused difficulties in the operation of the signal, and at times the mechanism had to be entirely disconnected. Doubts arose also as to the safety of using detonators near habitations and highways. But leaving these considerations out of the question, the detonating signal, which originally represented a danger or "stop" signal, is hardly suitable for indicating that a distant signal stands at "caution."

Experiments with electrically operated sirens and horns placed in front of the distant signal have not yet been completed. When the head of the train reaches a contact which is placed 300 metres (328 yards) in front of the distant signal, the latter standing at "caution," the siren or horn begins to sound and continues to do so until the head of the train reaches another contact placed 50 metres (55 yards) behind the distant signal. The apparatus is controlled from the signal cabin. The sound of the siren as a rule attracts the attention of the drivers of freight locomotives, but for drivers of passenger and express locomotives it does not seem to be sufficiently loud.

Another electric audible signal indicator is intended to give warning of the approach to a distant signal on the locomotive itself. When the train approaches the distant signal, a brush fixed to the locomotive comes into contact with two fixed contact bars placed next to the track. The armature of a relay on the locomotive drops off, a red disk appears, and an alarm is switched on. The results of trials of this apparatus have not been wholly satisfactory. The contact brushes have been repeatedly damaged by ballast and by other objects projecting into the boundary of the loading gauge, although the steel-wire brushes seem particularly suitable for making proper contacts even when the locomotive oscillates, and for yielding to any obstruction. When running at high speed, the apparatus sometimes fails to act.

The van Braam apparatus attempts to solve the problem by purely mechanical means. When a pair of slippers mounted on the locomotive slide on raised treadles placed alongside the track, a mechanism is set in motion which may be utilized for starting the compressed-air brake, for making a colored disk appear, and for operating a recording instrument. In the trials of this apparatus, the action on the brakes has been eliminated, both to lessen the complication of the apparatus and to avoid the danger of weakening the sense of responsibility and the attention of the drivers. The turning on of the steam whistle is reliably effected at speeds of from about 20 kilometers (12.5 miles) per hour upwards, if the slippers and treadles are in order. Unintentional turning on has occurred. The greatest difficulty, however, has been caused by the breaking of the slippers, due to their striking objects outside the loading gauge proper but very near to its boundary. Further, difficulties have arisen in the connection between the moveable treadles and the distant signals. It seems at the very least very doubtful whether it is possible to improve the treadles in such a way that they will always act reliably, especially under unfavorable conditions in winter. For this reason the experiments are to be continued with fixed treadles or bars instead of moveable treadles having a position dependent on that of the distant signal. The driver will be informed not how the distant signal is set, but only that he is approaching such a signal, just as in the case of the electrical apparatus described above.

The proposal to use wireless telegraphy for transmitting signals to the locomotive has also been taken into consideration. Electro-magnetic waves, which were continually produced at a sending station, were transmitted by induction to the telegraph wires along the track, and from them to a receiver placed on the locomotive. When an approach to a signal was to be indicated, the waves going to the receiver on the locomotive were intercepted by a screen. This brought a wave detector back to the zero position and a colored disk was shown. The experiments have shown that it is possible, within certain limits, to transmit signals to the locomotive. The strength of the waves, however, becomes materially decreased as the distance between the sending station and the locomotive increases. Further, the effect which the screen at the distant signal is intended to produce is produced in other ways—by telegraph lines crossing the railway, by iron bridges, by iron signal-poles. It is not yet likely that this apparatus will give useful results

On the other hand good results were shown by the so-called recording alarm, an apparatus intended to record the over-running of signals. A rail contact is placed next the home or block signal. If this is run over while the signal is at "danger," a recording alarm is set ringing at the place from which the signal is operated. In stopping the alarm a counter is advanced one; the over-running of the signal is recorded in this way, and the record makes it possible to investigate every case of over-running. If a signal is over-run at all frequently, the cause can be investigated and any existing unfavorable conditions can be remedied. The results have been so satisfactory that a large number of these recording alarms have already been ordered for German railways.

Summing up the conclusions to be drawn from these trials, Herr Hoogèn says that an "absolutely reliable" action cannot be demanded of appliances for the prevention of over-running, and will probably never be expected. But it may with justice be demanded that failures shall be the exception, when proper care is exercised in the care of the track appliances and the rolling stock. This standard has not yet been attained in the case of any of the appliances in question; it may be specially emphasized that it has not been attained in the case of the van Braam apparatus. The automatic protection of trains is, so far, inferior to alternating-current blocking, operated by signalmen.

AN ELECTROLYTIC OIL SEPARATOR.

A DESCRIPTION OF THE DAVIS-PERRETT ELECTROLYTIC OIL SEPARATOR, WITH DATA OF THE EFFICIENCY AND COST OF OPERATION.

Ridsdale Ellis—Society of Chemical Industry.

OIL is carried from engine cylinders by exhaust steam chiefly in the form of fine spray, but also to a considerable extent as vapor. The amount of oil carried by the steam is only one part in five or ten thousand, and hence, however high may be the boiling point of the oil, a considerable part of it, or at least of its more volatile constituents, must necessarily be vaporized. Oil separators of the baffle-plate type successfully remove the oil carried as spray, but, no matter how well they are designed, separators placed in the steam pipe cannot remove all the oil. Tests made at the Massachusetts Institute of Technology show that baffle-plate separators remove about 75 per cent. of the total oil contained in the steam. The remaining 25 per cent. goes to the condensers, and is there precipitated in the water in the form of very minute globules. A very small part of this residue can be separated by flotation, but after the larger drops have risen to the surface, a very stable, if very dilute, emulsion remains. The drops of oil in this emulsion are extremely small, and to their small size is due both the difficulty of separating them and also the properties similar to those of suspensions and of colloidal solutions possessed by the emulsion.

The chief characteristics of such an emulsion are dependent on the fact that the globules are electrically charged, which is shown by the fact that they migrate in an electric field. Not only does the close agreement between the velocity of migration of these oil globules and that of other colloidal solutions indicate that the emulsion may be treated exactly like a true colloidal solution, but the analogy is borne out by the fact that, as these oil globules are negatively charged, they can be precipitated by oppositely charged colloidal solutions —for example, colloidal ferric hydroxide. On this property of the emulsion is based the new Davis-Perrett oil-separating process, a description of which is taken from a recent paper by Ridsdale Ellis before the Society of Chemical Industry, reprinted in *The Electrician* for December 30, 1910.

"This process consists essentially in the electrolysis of the condenser water using iron electrodes, some electrolyte, usually sodium carbonate, being added to the water to raise its conductivity. Whatever the nature of the electrolyte, a basic salt is always produced on account of the alkali formed at the cathode. The precipitate formed entangles the oil globules, so that when the electrolysed solution is filtered all the oil is removed. Complete precipitation of the compounds of iron does not take place all at once, so that if the emulsion is filtered immediately the filtrate often contains colloidal ferrous compounds. If the emulsion is hot, as would be the case with condenser water, this colloidal solution is not formed. If treated cold the electrolysed solution should be allowed to stand for a little time before filtering, the presence of precipitated iron compounds producing the precipitation of the remainder of the iron. I obtained an analogous result when the oil was precipitated by colloidal ferric hydroxide In this case I found that above a certain concentration all the colloid was precipitated, however great the excess, that is within limits. From this it appears that the presence of the coagulated colloid brings about in some way the precipitation of the excess of colloid added. The same is true in the case of electrolysis, the colloidal solution obtained being only precipitated in the presence of the coagula. With colloidal ferric hydroxide the precipitation must occur on the surface of the oil globule, and the precipitation, which is apparently catalysed by the presence of coagulated ferric hydroxide, must continue as it began around the oil globule. The fact that the precipitation of the colloidal obtained by electrolysis only takes place in the presence of the coagula would point to the same mode of formation in the two cases. I then examined microscopically the precipitate produced, first, when the oil globules were coagulated by colloidal ferric hydroxide, secondly when the precipitate was produced by the electrolysis of a sodium carbonate solution using iron electrodes, and thirdly the precipitate obtained by precipitating basic ferrous sulphate in the water. The appearance of the precipitate produced in these three cases is exactly similar, which is a further proof that the electrolytic separation of the oil is extremely closely allied in its nature to colloidal coagulation, and consists in the precipitation of a positively charged compound around the negatively charged oil globules. Further, the similarity of the coagula shows that the function of electrolysis is merely to produce the precipitation in the water of a positively charged basic ferrous salt.

"There have been various attempts made to separate the oil from the condenser water by precipitating substances therein, and the general idea of cleansing water from suspended impurities by means of flocculent precipitates is an extremely well-known mode of water purification. The principal substances used for the purification of water from suspended impurities are ferric and aluminium hydroxides and other voluminous precipitates. . . . .

"The essential function of an electrolytic oil separator is to provide a simple and automatic means for precipitating in the water a basic ferrous salt, and in place of it we may use various filtering media or precipitate various flocculent precipitates in the solution. These remarks apply almost equally well to the separation of all suspensions, since practically all suspended particles are negatively charged, and will, therefore, behave in an exactly similar way to the oil globules. I have made some determinations in order to find out exactly how much of the oil is removed by this process. Since the oil in the emulsion rises gradually to the top of the liquid and adheres so strongly to the other oil particles on the surface that these visible agglomerates cannot be completely broken up by shaking, some other substance must be used as a standard of turbidity. For this purpose soap solutions of various concentrations were used.

"To compare the turbidity of two given liquids, such as an oil emulsion and soap solution, by means of transmitted light is very difficult, since evidently the precision of this method decreases as the percentage of the light cut off decreases. To overcome this trouble, and to get a quicker way of determining the content of oil, a simplified form of Richard's 'Nepthelometer' was employed. In the simplified form used for these experiments two test tubes are taken, the rims being cut off so that black paper tubes can be readily slid up and down the tubes. The ends of these tubes are covered with black paper to cut off any reflection in the curved ends. On looking down the black tubes into the liquid only the light reflected by the particles in the liquid is seen. The relative turbidity is then obtained by sliding up and down the black tubes until the amount of light reflected or the apparent turbidity is the same in both tubes. Then the amount of oil in each tube is, of course, inversely proportional to the length of tube exposed to the light.

"Using this apparatus, the efficiency of separation in the Davis-Perrett apparatus was found to be over 98.5 per cent., the actual amount of oil still contained in the water after treatment being less than one part in a million. This amount of oil is so small that it is impossible to detect it by direct comparison with distilled water, and the turbidity can only be detected by means of a Nepthelometer. I cannot give accurate figures for the separation of oil by means of filtering materials, though in the case of coke it would appear to be over 95 per cent., and a similar or higher efficiency for filtration through red ochre.

"As to the cost of operation, the two principal items are the electrical energy consumed and the soda or other substance added to the water. Using an emulsion of pure oil and pure water containing 1 part of oil and 20,000 of water, which is about the maximum content of oil ordinarily obtained in condenser water, I found that the minimum amount of electricity required was about 135 coulombs per gallon of water treated. This result was obtained on a small laboratory apparatus, but is, I think, sufficient to show the order of magnitude of the electrical energy required and to base one or two calculations as regards cost of operation.

"The following calculations were based on the assumption that bipolar electrodes are used, and that the current efficiency is 100 per cent. Where iron electrodes are used in a very dilute sodium carbonate solution the decomposition voltage is about 1.50 volts, but I found that efficient bipolar action can be readily obtained by making the holes in the plate or the spaces round the plate small. Using 50 iron plates, the current required for treating 1,000 gallons of feed water per hour will be 1.75 amperes, and at 230 volts the watt-hours will be 227—a ridiculously small amount. With electricity at 2d. per unit the cost of the current works out at ½d. per 1,000 gallons of feed water treated. The next item is the sodium carbonate added to raise the conductivity to the necessary amount. To each 1,000 gallons of feed water 1.5 pounds of sodium carbonate must be added. With carbonate at £5 10s. per ton, the cost per 1,000 gallons is then a fraction less than 1d. The last item is the renewal of the iron plates. As these plates are used as bipolar electrodes, they should not be used after their thickness is much less than ¼ inch. However, reckoning on a 12-hour day, the iron plates should be renewed every two years, so the cost of renewal need not be considered. These figures are based on the minimum amount of electricity and sodium carbonate, but it is evident that the cost is so slight that these amounts may be very considerably exceeded without making the cost prohibitive. Except for the addition of the sodium carbonate solution, the apparatus requires no attention, for a self-flushing filter which will cleanse itself periodically is usually installed.

"The apparatus may be further simplified by adding tap water instead of sodium carbonate solution, the calcium and other salts acting as the electrolytes. The amount of salts introduced will be less than that contained in ordinary hard water. Thus, supposing the water added contained only calcium carbonate, sufficient would have to be added for the condenser water to contain 9 grains per gallon. Chloride solutions may be added in place of carbonate, and hence sea water may be used if desired.

"There is a further consideration, and that is, What will be the effect on the boilers of a solution of a carbonate or other salt which has been electrolysed? Since alkali is always formed at the cathode, and the precipitate formed is not pure hydroxide, but a basic salt, there will always be a slight excess of alkali in the water introduced into the boilers. Since the water is very faintly alkaline, and since the corrosion of iron is proportional to the content of hydrogen in the water, the amount of corrosion will probably be less than is the case in ordinary pure water. Further, the apparatus appears to have a considerable field for use, not only in connection with the separation of oil from condenser water, for which it was primarily designed, but also for the treatment of other suspensions and colloidal solutions, and its cost in many cases would not appear to be prohibitive."

THE ENGINEERING INDEX

"THE KEYSTONE IN THE ARCH OF APPLIED SCIENCE."

The following pages form a *descriptive* index to the leading and special articles of permanent value published currently in the Transactions of all the important engineering societies of both Europe and America, and in all the leading engineering journals of the world—in the English, French, German, Dutch, Italian, and Spanish languages.

The term *descriptive* is used because the definite purpose of each index note is to indicate clearly the character and purpose of the article or paper described; and with that in view we give the following essential information about every publication:

(1) The title of the article,	(4) Its length in words,
(2) The name of its author,	(5) Where published,
(3) A descriptive abstract,	(6) When published,

(7) *We supply the article itself, if desired.*

☞ The full text of every article described in the Index, together with all its illustrations, can usually be supplied by us.—See the "Explanatory Note" at the end of the Index, where also the full titles of the principal journals indexed are given.

NOTE—The busy engineer will also observe that the Index is conveniently classified into the larger divisions of engineering science, to the end that the reader may quickly turn to what concerns himself and his special branches of work. By this means it is possible, within a few minutes' time each month, to learn promptly of every important article published anywhere in the world, in any language, upon the subjects claiming one's special interest.

DIVISIONS OF THE ENGINEERING INDEX.

CIVIL ENGINEERING	Page 795	MECHANICAL ENGINEERING	Page 814
ELECTRICAL ENGINEERING	" 804	MINING AND METALLURGY	" 826
INDUSTRIAL ECONOMY	" 810	RAILWAY ENGINEERING	" 834
MARINE AND NAVAL ENGINEERING	" 812	STREET AND ELECTRIC RAILWAYS	" 837

CIVIL ENGINEERING.

BRIDGES.

Arches.

The Arch Principle in Engineering and Esthetic Aspects, and Its Application to Long Spans. Discussion of the paper on this subject by C. R. Grimm. 4500 w. Pro Am Soc of Civ Engrs—Nov., 1910. No. 19036 F.

Exact Solution of a Five-Centered Arch. Harley G. Overholt. Mathematical. 200 w. Minn Engr—Nov., 1910. No. 19758 C.

Design.

Traction Stresses. S. Blumenthal. A study of these stresses as related to the design of bridge piers, trestle towers, and similar structures. 1000 w. Can Soc of Civ Engrs—Oct., 1910. No. 19016 N.

Erection.

Erecting a Bridge on a High False-work Tower. Illustrated description of work in Switzerland, in erecting the longest highest span in that country. 2000 w. Eng Rec—Dec. 17, 1910. No. 19383.

Lift Bridges.

The Wattrelos Hydraulic Lift Bridge (Note sur le Pont Levant Hydraulique de Wattrelos). M. Wibratte. Describes a bridge over the Roubaix Canal which carries heavy vehicular and street-car traffic. Ills. 3200 w. Ann d Ponts et Chaussées—1910-V. No. 19602 E + F.

Masonry.

See Viaducts, under BRIDGES.

Piers.

See Dikes, under WATERWAYS AND HARBORS.

Reconstruction.

Construction and Reconstruction of the Coteau Bridge. Illustrates and describes the building and rebuilding of a steel bridge on the Grand Trunk Ry., across the St. Lawrence River, under difficult and dangerous conditions. 2500 w. Eng Rec—Dec. 3, 1910. No. 19077.

Reinforced Concrete.

Reinforced Concrete Work on the Northern Pacific. Illustrates and describes the construction of trestles and bridges, explaining their advantages. 1000 w. Ry Age Gaz—Dec. 16, 1910. No. 19376.

The Meadow St. Reinforced-Concrete Arch Bridge, Pittsburg, Pa. N. S. Sprague. Explains conditions that led to the use of this material, and gives an illustrated detailed description of the bridge and its construction. 4500 w. Eng News—Dec. 1, 1910. No. 19050.

The New Charles River Bridge, Boston Elevated Railway. Illustrated detailed description of a reinforced-concrete 5-arch structure, between Boston and Cambridge, and the methods of construction. 2500 w. Eng Rec—Dec. 17, 1910. No. 19380.

See also Viaducts, under BRIDGES.

Steel.

Steel Arched Ribs for Railway Bridges. Considers the cost of the superstructure of a steel arch bridge, and compares the cost of the abutments with those required for a girder bridge. 2500 w. Engr, Lond—Dec. 9, 1910. No. 19447 A.

The Calvin Street Bridge, Buffalo. Illustrates and describes details of a four-span plate-girder bridge carrying four tracks of the N. Y. C. & H. R. R. R. 600 w. Eng Rec—Dec. 24, 1910. No. 19565.

The St. Louis Municipal Bridge Superstructure. Illustrated description of a bridge having three 668-ft. spans. The pin-connected trusses are of nickel steel, and the floor system and bracing will be of carbon steel. 2000 w. Eng Rec—Dec. 3, 1910. No. 19084.

Berlin's Municipal Bridges (Vom städtischen Brückenbau in Berlin). Describes the Swinemünder cantilever highway bridge. Ills. 2000 w. Deutsche Bau—Nov. 16, 1910. No. 19690 B.

The New Bridge over the Drau at Marburg (Der Neubau der Draubrücke in Marburg). Describes a three-span steel arch structure with masonry approaches. Ills. 3600 w. Oest Wochenschr f d Oeffent Baudienst—Nov. 5, 1910. No. 19812 D.

The Kaiser Franz Josef Bridge over the Elbe at Leitmeritz (Die Eröffnung der Kaiser Franz Josef-Brücke über die Elbe in Leitmeritz). The bridge has eight steel truss spans. Ills. 2800 w. Oest Wochenschr f d Oeffent Baudienst—Nov. 12, 1910. No. 19813 D.

The Construction of the Bridge over the Danube for the Second Line of the Northwest Railway, Vienna (Ueber den Bau der Donaubrücke für das Zweite Gleis der Nordwestbahn in Wien). Josef Walter. Describes the duplication of an existing steel structure alongside the latter. Ills. 2800 w. Zeitschr d Oest Ing u Arch Ver—Nov. 11, 1910. No. 19810 D.

See also Erection, under BRIDGES.

Testing.

See Bridge Testing, under RAILWAY ENGINEERING, PERMANENT WAY AND BUILDINGS.

Viaducts.

The Baltimore & Ohio Viaduct Over Brandywine Creek. Illustrated description of a double-track stone viaduct at Wilmington, Del. 2000 w. Eng Rec—Dec. 17, 1910. No. 19382.

The Asylum Ave. Concrete Viaduct, Knoxville, Tenn. L. W. Frierson. Illustrates and describes a reinforced concrete flat girder bridge resting on braced column bents. 1000 w. Eng News—Dec. 15, 1910. No. 19354.

The St. Jean La Riviere Viaduct. Illustrated description of a reinforced-concrete arch with a span of 149.2 ft. on centers, and the method of erection. 1500 w. Eng Rec—Dec. 3, 1910. No. 19083.

The Sitter Viaduct, near St. Gall, Switzerland (Viaduc sur la Sitter, à Kubel, près de Saint-Gall, Suisse). Brief description of the design and construction of this very high structure of masonry with one steel span. Ills. 4200 w. Génie Civil—Nov. 26, 1910. No. 19644 D.

The Horst-Emscher Tramway Viaduct (Strassenbahn - Viaduct bei Horst-Emscher). Herr Färber. Describes an important reinforced-concrete structure with one long arch span. Ills. Serial. 1st part. 1400 w. Deutsche Bau—Nov. 2, 1910. No. 19688 B.

CONSTRUCTION.

Boring.

Diamond-Drill Borings for a Dam on the Clackamas River (Oregon). Condensed from a paper by V. J. Hampton, in *Mines and Quarries*. Illustrated description of borings made, and information concerning the progress and methods of work. 1700 w. Eng News—Dec. 22, 1910. No. 19484.

Columns.

Eccentrically-Loaded Columns. Walter Elsworthy Lilly. Describes tests made, comparing the values with those derived from formulae applicable to the cases considered. Discusses principles, and gives reasons for the choice of formulae adopted. Ills. 4500 w. Inst of Civ Engrs—No. 3849. No. 19472 N.

Concrete.

Studies in Economic Construction. An illustrated outline of research work in building construction, with particular reference to the use of concrete in model dwellings. 5000 w. Cement Age—Dec., 1910. No. 19521 C.

How to Put in Concrete Work in Winter Months. Ernest McCullough. Suggestions for obtaining satisfactory results in freezing weather. 1500 w. Min Wld—Dec. 24, 1910. No. 19561.

Conveying and Depositing Concrete by Gravity Chutes. Illustrated description of the plant and its operation. 2500 w. Eng News—Dec. 8, 1910. No. 19240.

Large Portable Plant for Crushing, Mixing, and Placing Concrete on Catskill Aqueduct. Illustrated description of plant and methods. 2500 w. Engng Con—Dec. 7, 1910. No. 19220.

Methods and Cost of Concrete Work at the Gatun Locks of the Panama Canal. Plan and description of the construction plant and methods. Ills. 2000 w. Engng Con—Dec. 7, 1910. No. 19221.

The Cost of Concrete on the Panama Canal Locks. Gives a table of construction expenditures on the Panama Canal to Sept. 30, 1910, and a table of unit costs of concrete. 1200 w. Eng Rec—Dec. 3, 1910. No. 19078.

See also Fishery Harbors, under WATERWAYS AND HARBORS.

Contractors' Plants.

See Concrete, under CONSTRUCTION.

Excavation.

Excavation Methods, Fourth Avenue Subway, Brooklyn. Illustrates and describes four methods used by different contractors, almost wholly in earth and sand, with occasional boulders but no solid rock. 1800 w. Eng Rec—Dec. 3, 1910. No. 19080.

Failures.

The Collapse of the Reinforced-Concrete Henke Building, Cleveland, Ohio. Illustrates and describes the failure of a 4-story building about completed. 800 w. Eng News—Dec. 8, 1910. No. 19241.

Fireproof.

See Gypsum, and Heat Changes, under MATERIALS OF CONSTRUCTION.

Floors.

The Calculation of Plates, Supported by Four Columns. L. J. Mensch. Read before the Nat. Assn. of Cement Users. Compares the theory of plates supported by four columns with the theory, practice, and tests of round and square plates. Mathematical. 1400 w. Engng-Con—Dec. 28, 1910. No. 19783.

The Basis of Design for Flat Concrete Floor Slabs. A discussion by Arthur R. Lord before the Nat. Assn. of Cement Users. States evidence of tests made applicable to a consideration of the basis of design for reinforced-concrete floor slabs. 3000 w. Eng Rec—Dec. 24, 1910. No. 19566.

A Test of a Flat Slab Floor in a Reinforced-Concrete Building. Arthur R. Lord. Read before the Nat. Assn. of Cement Users. Describes a test for actual stresses. Ills. 4000 w. Eng News—Dec. 22, 1910. No. 19486.

Foundations.

Grouting Natural Soils for Bridge and Building Foundations. W. D'Rohan. Discusses the value of the method of F. A. Lart for solidifying the natural ground under foundations. 1000 w. Engng-Con—Dec. 21, 1910. No. 19476.

The Windsor Station Foundations, Montreal. Describes method of building about 300 concrete piers through soil of varied character. Ills. 1200 w. Eng Rec—Dec. 3, 1910. No. 19088.

Foundations for the Municipal Building, New York. Maurice Deutsch. Illustrated description of interesting and difficult foundations for a 25-story building, with a tower having 15 additional stories. 4500 w. Sch of Mines Qr—Nov., 1910. No. 19733 D.

Concrete Pile Foundations, with Reference to the Simplex Method of Constructing the Same. Alex. Melville. Brief review of the various methods of constructing pile foundations, with description of the "Simplex" system and its use. Ills. 5000 w. Inst of Engrs & Shipbldrs in Scotland—Nov. 23, 1909. No. 19770 N.

The Substructure of the Bankers Trust Company's Building. The foundations for a 43-story building in New York, with four floors below the street level, are illustrated and described. 2500 w. Eng Rec—Dec. 10, 1910. No. 19277.

Oil Reservoirs.

Largest Concrete Oil Reservoirs in the World. Hamilton M. Wright. Illustrations of reservoirs at Tank Farm, California, with brief description. 700 w. Sci Am—Dec. 10, 1910. No. 19246.

Piling.

Sheet Piling. Ewing Matheson. Describes some early applications. Ills. 1800 w. Cassier's Mag—Dec., 1910. No. 19542 B.

Practical Notes on Making and Driving Reinforced Concrete Piles. Vere Sussex Hyde. Practical directions for the work. 2500 w. Prac Engr—Nov. 25, 1910. No. 19188 A.

Reinforced Concrete Pile. Edward Mohun. Illustrated description of the method, invented by the author, of reinforcing molded concrete piles by the use of angles in connection with expanded metal. 1000 w. Can Engr—Dec. 1, 1910. No. 19152.

Reclamation.

Reclamation of the Southern Louisiana Wet Prairie Lands. A. D. Morehouse. An illustrated article based on reports to the chief of drainage investigations. Gives information concerning the development of these lands, now in progress. Ills. 8000 w. U S Dept of Agri—Reprint from Report of June 30, 1909. No. 19762 N.

Reinforced Concrete.

Concrete Reinforcement (Le Béton de Ciment armé). C. Codron. A critical analysis of J. Toupet's paper before the Engineers Society of Western Pennsylvania. Ills. Serial. 1st part. 2500 w. Tech Mod—Nov., 1910. No. 19618 D.

Flat Slabs Between Iron Beams (Flachgewölbe und ebene Platten zwischen Eisenträgern). R. Saliger. Discusses results of tests on reinforced concrete slabs. Ills. 2700 w. Zeitschr d Oest Ing u Arch Ver—Nov. 25, 1910. No. 19811 D.

The Use of Concrete for the Bush Terminal Development. A. D. Mellor. Illustrated description of the use of reinforced-concrete in the Bush Terminal at South Brooklyn, for the solving of the freight problem. 2000 w. Cement Age—Dec., 1910. No. 19522 C.

Grandstand and Grounds of the Cleveland Baseball Club. Plan and description of a new installation. All the structures are of reinforced-concrete and structural steel. 1600 w. Eng Rec—Dec. 17, 1910. No. 19387.

Reinforced Concrete Car House, Dayton, Ohio. J. C. Lathrop. Illustrated description of the general plan of the property of the People's Railway Co., and the construction of the car house. 2500 w. Elec Ry Jour—Dec. 31, 1910. No. 19781.

Design of Two Large Reinforced Concrete Buildings. M. E. Thomas. Illustrated description of new shops for the General Electric Co., at Schenectady, N. Y. 2500 w. Eng Rec—Dec. 10, 1910. No. 19270.

A Large Concrete Coal Breaker and Washery Building. Illustrated description of an interesting structure recently completed at Taylor, Pa., near Scranton. 2500 w. Eng Rec—Dec. 3, 1910. No. 19079.

The Construction in Reinforced Concrete of the Basilea Municipal Theatre (Le Costruzioni in Cemento Armato del Teatro Municipale di Basilea). A brief description of the design and erection. Ills. 2000 w. Il Cemento—Nov. 15, 1910. No. 19657 D.

Two Monumental Reinforced-Concrete Halls (Zwei monumentale Hallenbauten in Eisenbeton). H. Spangenberg. Describes the design and construction of two large concrete buildings. Ills. Serial. 1st part. 2500 w. Schweiz Bau—Nov. 19, 1910. No. 19694 B.

See also Failures, Floors, and Oil Reservoirs, under CONSTRUCTION; Tanks, under WATER SUPPLY; Piers, under WATERWAYS AND HARBORS; and Boiler Settings, under MECHANICAL ENGINEERING, STEAM ENGINEERING.

Retaining Walls.

The Design of Retaining Walls. Edward Godfrey. A critical discussion of designs and methods of determining stability. Ills. 4500 w. Engng-Con—Dec. 21, 1910. No. 19477.

Enlargement of the Track Space at the Saint Lazare Station, Paris (Elargissement du Goulot de la Gare Saint-Lazare). Charles Rabut. Describes some features of the retaining-wall construction. Ills. 1800 w. Génie Civil—Nov. 5, 1910. No. 19639 D.

Steel.

Stanchions Carrying Eccentric Loads. Ernest G. Beck. A mathematical solution of the problem of determining the stresses induced. 1200 w. Engr, Lond—Dec. 2, 1910. No. 19334 A.

Subways.

Construction of a Portion of the Fourth Avenue Subway, Brooklyn. The section from 10th St. to 27th St. is illustrated and described, with the scheme of the construction work. 3000 w. Eng Rec—Dec. 17, 1910. No. 19384.

Tunnels.

The Hudson River Tunnels of the Hudson and Manhattan Railroad Company. Charles Mattathias Jacobs. History and illustrated description, with abstract of discussion. 36500 w. Inst of Civ Engrs—No. 3859. No. 17474 N.

See also same title, under RAILWAY ENGINEERING, PERMANENT WAY AND BUILDINGS.

Underpinning.

Underpinning the Manhasset Building, New York. Illustrated description of the underpinning necessary in changing the first floor of a 12-story apartment house into stores. 2000 w. Eng Rec—Dec. 10, 1910. No. 19275.

Waterproofing.

Waterproofing the New Ulm Concrete Reservoir. A 1,000,000-gal. reservoir in Minnesota is described; its troubles with leaks, and their repair. Ills. 1000 w. Eng Rec—Dec. 17, 1910. No. 19385.

MATERIALS OF CONSTRUCTION.

Brick.

The Development of English Brickwork. H. Franklyn Murrell. Read before the Inst. of Bldrs. Illustrates and describes some beautiful work executed in this material. 2000 w. Archt, Lond—Dec. 2, 1910. Serial. 1st part. No. 19308 A.

Cement.

Puzzolan-Portland Cement; A Suggestion for an Improved Hydraulic Cement. Edward Durfee. Information concerning a means of obtaining a cement that will secure mortars permanently waterproof and of better color for architectural uses. 3000 w. Eng News—Dec. 1, 1910. No. 19054.

Concrete.

Some Thermal Properties of Concrete. Charles L. Norton. Read before the Nat. Assn. of Cement Users. Discusses results of a study of various physical properties of concrete over a wide range of temperatures. 3000 w. Eng Rec—Dec. 24, 1910. No. 19570.

Concrete and Concrete Tests. Alfred E. Corbett. Read before the Manchester Soc. of Archts. A report of tests made to obtain an impervious concrete with a crushing strength of 154 tons per sq. ft. when 28 days old. 6000 w. Jour Roy Inst of British Archts—Nov. 12, 1910. No. 19337 B.

Concrete Blocks.

Density and Strength of Concrete Blocks Cast in Sand Molds. R. C. Carpenter. Gives results and describes tests made by pouring the same mixture into different kinds of molds. Those made in sand molds showed great superiority. 1200 w. Sib Jour of Engng—Nov., 1910. No. 19022 C.

Gypsum.

Gypsum as a Fireproofing Material. From a pamphlet by H. G. Perring. Information regarding the fire-resisting qualities of gypsum. 1800 w. Eng Rec—Dec. 3, 1910. No. 19087.

Heat Changes.

Heat Changes in Structural Materials. James E. Howard. Extracts from a paper read before the Nat. Assn. of Mutual Ins. Co.'s. Discusses the relation of temperature to tensile and compressive strength. 2000 w. Ir Age—Dec. 1, 1910. No. 19041.

Mortars.

The Diversity of the Results Obtained in Tests of Cement Mortars Using Sands of Different Compositions (Sulle Differenze dei Risultati Ottenuti nelle Prove dei Sementi Adoperando Sabbie di Differenti Nature). Quotes test results to show the importance of the quality of the sand used in cement mortars. 2700 w. Il Cemento —Nov. 30, 1910. No. 19660 D.

See Cement Testing, under MEASUREMENT.

Reinforced Concrete.

Reinforced Concrete. C. A. P. Turner. Discusses the materials that enter into the combination, the methods of inspecting and selecting them, and their suitability, the problems in the combination of concrete and steel in building construction, etc. 4500 w. Minn Engr—Nov., 1910. No. 19757 C.

An Investigation of the Corrosion of Iron Imbedded in Concrete. Guy F. Shaffer. An illustrated study of the action of stray currents. 2500 w. Harvard Engng Jour—Nov., 1910. No. 19754 D.

Further Tests on the Effect of Electric Currents Upon Concrete and Steel. U. James Nicholas. An illustrated report of research work carried out at the Univ. of Melbourne with the object of studying the effect of currents on reinforced concrete. 3500 w. Eng News—Dec. 1, 1910. No. 19052.

Timber.

Some Tests of Old Timber. C. P. Buchanan. Shows, as a result of tests, that timber 25 years old is stronger than new stock. 1000 w. Eng News—Dec. 8, 1910. No. 19236.

Timber Preservation.

Timber Preservation, Its Development and Present Scope. Walter Buehler. Considers Burnettizing and creosoting as the two basic processes. 3500 w. Pro Am Soc of Civ Engrs—Nov., 1910. No. 19034 F.

The Preservation of Structural Timbers from Decay. C. P. Winslow. Aims to point out the principles which determine the success of any treatment, discussing the preservatives and processes now in use. Ills. 14500 w. Pro Engrs' Soc of W Penn—Dec., 1910. No. 19547 D.

Wood Preservation. A. L. Kuehn. Abstract of paper read before the Cent. Elec. Ry. Assn. Considers the causes of decay, preservatives and methods of preservation used. 2500 w. Elec Ry Jour—Dec. 3, 1910. No. 19148.

The Preservation of Timber (Die Konservierung des Holzes). Th. Wolff. Discusses the preservative treatment of wood for the purposes of marine and naval construction. 5000 w. Schiffbau—Nov. 9, 1910. No. 19686 D.

MEASUREMENT.

Cement Testing.

Acceptance Tests for Cement Materials (Intorno all'Assaggio ed al Collaudo dei Materiali Cementizi e delle Malte). Discusses the composition and testing of cement mortars. Serial. 1st part. 2300 w. Industria—Nov. 6, 1910. No. 19655 D.

Hydrographic Surveying.

Wire Drag Work of the United States Coast and Geodetic Survey. Illustrates and describes a method of hydrographic surveying which will verify least depths over an entire area. 2500 w. Eng News —Dec. 1, 1910. No. 19051.

Surveying.

Deep Tunnel Alignment from Shafts. Herbert M. Hale. Explains methods of underground surveying in connection with the work of the Catskill water supply for New York City. Ills. 3000 w. Harvard Engng Jour—Nov., 1910. No. 19755 D.

MUNICIPAL.

Budget Exhibit.

An Influence for Efficiency in Municipal Administration. Herbert T. Wade. An illustrated discussion of the New York Budget Exhibit of 1910, and its value. 4500 w. Engineering Magazine—Jan., 1911. No. 19747 B.

City Planning.

The Planning of an Industrial Suburb. E. A. Slater. Illustrated description of a design, the distinguishing characteristic being a central rectangular open space for games, walks, etc. 2000 w. Surveyor—Dec. 2, 1910. No. 19319 A.

Industrial Wastes.

The Disposal of Trade Wastes. George A. Johnson. Portions of a paper read before the N. J. San. Assn. General discussion. 1500 w. Eng News—Dec. 8, 1910. No. 19242.

Organization.

Boston's New Department of Public Works Under One Engineering Head. Benjamin Baker. Describes a new plan of organization devised by L. K. Rourke. Also editorial. 4000 w. Eng News—Dec. 22, 1910. No. 19485.

Pavements.

A New Paving Material (Un Nuovo Materiale da Pavimentazione). A description of "Rostolit" artificial stone. Ills. 2000 w. Il Cemento—Nov. 15, 1910. No. 19659 D.

Wood Block Pavements. Synopsis of information collected by the Am. Soc. of Munic. Imp. 3000 w. Munic Jour of Engr—Dec. 7, 1910. No. 19209.

I. Specifications for Asphalt Pavements. E. M. Purdue. II. Proposed Specifications for Sheet Asphalt Pavements. F. P. Smith. Also editorial. Objections to some of the principles on which specifications are based. 6000 w. Munic Engng —Dec., 1910. No. 19731 C.

Refuse Destructors.

Easton Garbage Incinerator. John McNeal. Illustrated description of a 35-ton plant, with cost of operation. 1500 w. Munic Jour & Engr—Dec. 28, 1910. No. 19780.

Combined Destructor and Electricity Works. E. Kilburn Scott. Gives a summary of data collected in regard to such plants and their management. 1500 w. Elec Rev, Lond—Dec. 9, 1910. No. 19424 A.

Road Rollers.

Recent Types of Road Rollers (Ueber Strassenwalzen neuerer Konstruktion). Karl Breitenfelder. Describes both steam and oil-engine rollers. Ills. 4600 w. Oest Wochenschr f d Oeffent Baudienst—Nov. 26, 1910. No. 19815 D.

Roads.

The Working of the "Road Development Act, 1909." Reginald Brown. Discusses needed improvements in highways and how they are to be accomplished. Ills. 7000 w. Soc of Engrs—Dec. 5, 1910. No. 19431 N.

The United States Office of Public Roads. Explains the purpose and scope of the work. Ills. 4000 w. Eng Rec—Dec. 17, 1910. No. 19389.

State Aid in Road Building. Logan Waller Page. Read before the Am. Road Bldrs. Assn. Reviews the history of road building in the United States and explains the principles which the author considers should govern the framing of a State highway law. 4000 w. Eng Rec—Dec. 24, 1910. No. 19567.

Road Construction in the United States. W. W. Crosby. Read at the Nat. Good Roads convention. Discusses the practice of the modern highway engineer. 3500 w. Com Veh—Nov. & Dec., 1910. Serial. 2 parts. No. 19166 each C.

Notes on the Construction of Gravel Roads. From the Third Biennial Report of the Mich. Highway Dept. Deals with grading, tools required, graveling, rolling, etc. 2500 w. Engng-Con—Dec. 28, 1910. No. 19784.

Top Soil Roads in Clarke County, Georgia. C. M. Strahan. Explains the method of constructing these roads, their low cost and cheap maintenance. 2000 w. Munic Engng—Dec., 1910. No. 19732 C.

Two Years' Experience in Dust Suppression on New Jersey Roads. James Owen. Read before the State San. Assn. of N. J. Gives the experience in one locality in the effort to attain a dustless road. 3000 w. Eng Rec—Dec. 10, 1910. No. 19274.

Free Carbon in Tar. Joseph Race. Gives information and investigations of interest to road engineers and makers of tar-macadam. 2500 w. Surveyor—Nov. 25, 1910. No. 19185 A.

Surface Treatment for Dust Laying. Suggestions as to the most effective means of dealing with this problem. 2000 w. Surveyor—Nov. 25, 1910. No. 19186 A.

The Dust Problem on Roads (Routes et Pouissière). Paul Etier. Read at the Second Road Congress. A report on conditions in Switzerland, the first part dealing with macadam roads. Ills. Serial. 1st part. 2500 w. Bul Tech d l Suisse Romande—Nov. 25, 1910. No. 19636 D.

Sewage Disposal.

Sewage Disposal in Europe. Rudolph Hering. Presented to the Am. Inst. of Chem. Engrs. A study of the methods now used. 4000 w. Eng Rec—Dec. 17, 1910. No. 19388.

The Sludge Problem. W. C. Easdale. Read before the Assn. of Mgrs. of Sewage Disposal Works. Presents arguments in support of a new method of disposing of, or preventing the formation of sludge. 3300 w. Surveyor—Dec. 9, 1910. No. 19432 A.

A New Method of Handling Sewage Sludge. Dr. Karl Imhoff and Charles Saville. Illustrated detailed account of methods used in Germany and now to be introduced extensively at Atlanta, Ga. 5000 w. Eng Rec—Dec. 10, 1910. No. 19276.

I. Birmingham Sewage Disposal Works. John Duncan Watson. II. Salisbury Drainage. William James Eames Birnie. Descriptive papers, with abstract of the discussion. Ills. 14000 w. Inst of Civ Engrs. No. 3865 and No. 3858. No. 19475 N.

A German Sanitary District and the Imhoff Sewage Purification Tank. Charles Saville. With introduction by Rudolph Hering. Also editorial. Description and general information concerning this German tank, said to make possible the purification of sewage without offensive odor. Ills. 7000 w. Eng News—Dec. 1, 1910. No. 19058.

The Department of the Seine and the Bacterial Purification of Sewage (Le Département de la Seine et l'Epuration bactérienne des Eaux d'Egout). M. Mahieu. Discusses the problem of sewage disposal in Paris and describes the recent projects for sewage purification plants and the new works already executed. Ills. 14700 w. Ann d Ponts et Chaussées—1910-V. No. 19603 E. + F.

Sewers.

Hartford East Side Intercepting Sewer. Illustrated description of a sewer under construction to prevent floods and purify the harbor. 4500 w. Munic Jour & Engr—Dec. 14, 1910. No. 19343.

Intercepting Sewers and Outfall at New Bedford. Data regarding conditions along the city's water front, and the means to be adopted to better them by improving the sewerage system. Ills. 1200 w. Eng Rec—Dec. 17, 1910. No. 19381.

The Jones Falls Covered Conduits and Boulevard, Baltimore. Plans and description of a triple-barrel reinforced concrete conduit supporting a roadway and sidewalks to be constructed. 1200 w. Eng Rec—Dec. 3, 1910. No. 19082.

The North Trunk Sewer in Seattle. Explains conditions and outlines the work in progress, giving an illustrated detailed description of the North Trunk sewer. 3000 w. Eng Rec—Dec. 10, 1910. No. 19273.

Snow Plows.

Snow Plows for City Use. Illustrates and describes various types to meet different requirements. 3000 w. Munic Jour & Engr—Dec. 7, 1910. No. 19208.

Snow Removal.

Snow Removal in New York. Walter G. Turini. Describes the methods employed, with special reference to the work of 1909-10. 1800 w. Munic Jour & Engr—Dec. 21, 1910. No. 19508.

Street Cleaning.

The Necessity for a Technical Organization in Street Cleaning (Della Necessita di un'Organizzazione Tecnica dei Servizi della Nettezza Urbana). Riccardo Badoglio. Discusses the essentially engineering nature of the street-cleaning problem. 8400 w. Ann d Soc d Ing e d Arch Ital—Oct. 1, 1910. No. 19647 F.

WATER SUPPLY.

Dams.

Design and Computations for a Cellular Reinforced Concrete Dam. George J. Bancroft. Abstract of a paper read before the Colo. Sci. Soc. Describes a dam built like a honeycomb, the cells being vertical. The cells are filled with earth and rock. 3000 w. Engng Con—Dec. 14, 1910. No. 19344.

Reconstruction of Marshall Lake Dam. I. G. Harmon. Illustrated detailed description of work in Colorado, explaining conditions. 2000 w. Eng Rec—Dec. 24, 1910. No. 19569.

Movable Dams on the New York State Barge Canal. Illustrated detailed description of the type adopted, known as the bridge dam with the Boulé gates. 3000 w. Eng News—Dec. 8, 1910. No. 19231.

Repairs to the Gigny Dam on the Saône (Réparations des Avaries survenues au Barrage de Gigny sur la Saône). Henri Tavernier. Describes the repair of cracks and cavities in the concrete foundations and in the body of the dam. Ills. 2500 w. Ann d Ponts et Chaussées—1910-V. No. 19601 E + F.

See also Boring, under CONSTRUCTION.

Filtration.

Minneapolis Filters. J. Arthur Jensen. Describes the form of purification adopted for improving the supply from the Mississippi River. 1200 w. Minn Engr—Nov., 1910. No. 19760 C.

See also Sheffield, under WATER SUPPLY.

Gravity Distribution.

A Case of Water Distribution Entirely by Gravity (Un Caso Singolare di Distribuzione d'Acqua merce la Sola Energia di Gravita dell'Acqua Condotta). Elia Ovazza. Examines the case of a city very favorably located for gravity distribution, discussing the determination of the best method and apparatus to employ. Ills. 3700 w. Monit Tech—Nov. 30, 1910. No. 19654 D.

Irrigation.

A Few Notes on Irrigation. Boris Levitt. Brief information concerning things affecting the water supply, methods of irrigation and use, etc. 2500 w. Sch of Mines Qr—Dec., 1910. No. 19735 D.

Hydrography as an Aid to the Successful Operation of an Irrigation System. J. C. Stevens. A discussion of hydrographic work as conducted on the Sunnyside project of the U. S. Reclamation Service, in Washington. Map and curves. 7500 w. Pro Am Soc of Civ Engrs—Nov., 1910. No. 19032 F.

The Economy of the Prevention of Conveyance Losses of Irrigation Water and the Use of Concrete for the Economical Construction of Irrigation Structures. Prof. Etcheverry. Read before the W. Can. Ir. Assn. Discusses seepage and evaporation losses, and the use of concrete. 5500 w. Can Engr—Dec. 22, 1910. No. 19558.

The Function of the State Engineer in the Arid and Semi-Arid States. Samuel H. Lea. Condensed from address at the Nat. Irrigation Cong. Deals principally with their work in relation to irrigation and public control of water. 1500 w. Eng News—Dec. 1, 1910. No. 19055.

Pipe Flow.

Graphic Calculation of the Flow of Water in Pipes. T. G. Bocking. Refers briefly to various formulae, and gives a graphical solution. 2500 w. Engr, Lond—Nov. 25, 1910. No. 19195 A.

Pipe Laying.

Laying Large Submerged Gas Mains at New York. From a paper by Colin C. Simpson, read before the Am. Gas Inst. Illustrated description of how the operations were conducted in laying mains under the Harlem River. 3000 w. Eng Rec—Dec. 3, 1910. No. 19086.

Pipe Lines.

The New 30-In. Cast Iron Conduit from Lake Skaneateles to Syracuse, Syracuse Water Works. M. B. Palmer. Describes a second conduit recently laid to increase the supply, and a standpipe. Ills. 5000 w. Engng-Con—Nov. 30, 1910. No. 19046.

See also Reservoirs, under WATER SUPPLY.

Purification.

The Purification of Public Water Supplies. T. Aird Murray. Discusses principally the methods and principles for the removal of disease-producing organisms. 3500 w. Ap Sci—Dec., 1910. No. 19724 C.

The Eliminating Effect of Chlorine Upon the Bacteria of a River Water. Leslie C. Walker. Read before the Assn. of Water Engrs. States facts ascertained during a trial to test the efficiency of the De-Clor system, which claims to remove excretal bacteria from water intended for domestic uses. Also general discussion. 7000 w. Surveyor—Dec. 16, 1910. No. 19587 A.

Water Purification Plant at Newport, R. I. Illustrated detailed description of a satisfactory plant. 2500 w. Munic Jour & Engr—Dec. 28, 1910. No. 19779.

Reservoirs.

Covered Service Reservoir at Ambergate. Illustrates and describes this reservoir and pipe lines of the Derwent Valley scheme. 1000 w. Engr, Lond—Dec. 16, 1910. No. 19700 A.

See also Waterproofing, under CONSTRUCTION.

Sheffield.

I. Notes on the Sheffield Water Supply, and Statistics Relating Thereto. Leonard Swaine Morelock Marsh. II. Statistical and Experimental Data on Filtration. William Ralph Baldwin-Wiseman. III. Abstract of discussion and correspondence on the two papers. Ills. 63000 w. Inst of Civ Engrs—No. 3795 & No. 3818. No. 19473 N.

Sterilization.

Sterilization of Polluted Water by Ultra-Violet Rays at Marseilles, France. From *Le Genie Civil.* Gives results of the operation of an experimental plant. 800 w. Eng News—Dec. 8, 1910. No. 19239.

The Sterilization of Large Quantities of Water by Means of Ultra-Violet Rays (La Sterilisation de Grandes Quantités d'Eau par les Rayons Ultraviolets). Max de Recklinghausen. Describes the Marseilles installation. Ills. 2500 w. Génie Civil—Nov. 5, 1910. No. 19640 D.

The Effects of Ultra-Violet Rays (Wirkungen der ultravioletten Strahlen). Erich Schneckenberg. Discusses their effect on bacteria and on various fluids and chemicals. 4200 w. Elektrotech u Maschinenbau—Nov. 20, 1910. No. 19831 D.

Sterilization of Water by Ultra-Violet Light (Industrielle Wassersterilisation mit Ultra-violettem Licht). Max von Recklinghausen. Describes the theory, the apparatus, and the results. Ills. Serial. 1st part. 2400 w. Elektrochem Zeitschr—Nov., 1910. No. 19662 D.

Tanks.

A Reinforced-Concrete Water Tank with Dome-Shaped Bottom. L. A. Waterbury. Illustrated description of the tank erected on the Campus of the University of Arizona, at Tucson. 1500 w. Eng News—Dec. 15, 1910. No. 19359.

See also Oil Reservoirs, under CONSTRUCTION.

Vancouver, B. C.

A New Water Supply for the City of Vancouver, B. C., H. M. Burwell. An illustrated description of the new system from Seymour Creek, made necessary by increase in population. 3500 w. Can Soc of Civ Engrs—Dec. 8, 1910. No. 19526 N.

Water Towers.

A Tall Concrete Block Water Tower Near Brussels. From *Le Génie Civil.* Illustration, with brief description. 1200 w. Eng Rec—Dec. 10, 1910. No. 19272.

See also Pipe Lines, under WATER SUPPLY.

Water-Works Management.

Some Comments on Water Works Management. Leonard Metcalf. Read before the Penn. W-Wks. Assn. Examines statistics of the operation of public water-works in the United States. 3000 w. Eng Rec—Dec. 24, 1910. No. 19571.

Wells.

Methods and Cost of Sinking and Lining a Dug Well on Long Island. J. L. Ingle, Jr. Detailed description of the work. 2000 w. Engng-Con—Dec. 7, 1910. No. 19222.

See also Boring, under MINING AND METALLURGY, MINING.

WATERWAYS AND HARBORS.

Breakwaters.

The Construction of the Djidjelli Breakwater (Note sur la Construction de la Jetée de Djidjelli). M. Daujon. A description of the design and construction of the new works at this Algerian port. Ills. 10500 w. Ann d Ponts et Chaussées —1910-V. No. 19600 E + F.

Canal Gates.

Emergency Gates on the Illinois and Mississippi Canal. Illustrated description prepared from a paper by Maj. C. S. Riche, describing gates built on the Hennepin Canal. 1500 w. Eng News—Dec. 15, 1910. No. 19363.

Canals.

The History and Economic Value of Canals, with Special Reference to the Cape Cod Canal. Com. J. W. Miller. Historical review of canals in the United States, with description of the Cape Cod Canal. Discussion. Ills. 4500 w. Soc of Nav Archts & Marine Engrs, No. 3—Nov. 17, 1910. No. 19462 N.

Progress in the Canalization of the Moldau and the Elbe in Bohemia during 1909 (Kommission für die Kanalisierung des Moldau- und Elbeflusses in Böhmen, Tätigkeit im Jahre 1909). Brief review of the projects, with report of progress. Ills. 4200 w. Oest Wochenschr f d Oeffent Baudienst—Nov. 19, 1910. No. 19814 D.

Danube.

The Danube in Lower Austria (Le Danube dans la Basse Autriche). M. Armand. Describes the regimen of the river and the means of regulation adopted. Ills. 9800 w. Ann de Ponts et Chaussées—1910-V. No. 19604 E + F.

Dikes.

Permeable Dike Construction for Protecting a Bridge Substructure, Chicago. Milwaukee & St. Paul Ry. Illustrates and describes work at Mobridge, S. D., for the protection of a bridge across the Missouri River. 1200 w. Engng-Con—Dec. 7, 1910. No. 19223.

Dry Docks.

Floating Dry Docks in the United States; Relative Value of Wood and Steel for Their Construction. William T. Donnelly. Compares these materials, and the methods for their care and preservation. Ills. 2500 w. Soc Nav Archts & Marine Engrs, No. 5—Nov. 17, 1910. No. 19464 N.

Fishery Harbors.

The Fishery Harbors of Scotland. John Taylor. Brief review of the history of the industry, with illustrated detailed description of a fine example of minor harbor construction. Especially interesting because of the extensive use of cement concrete in sea water. 11000 w. Eng News—Dec. 22, 1910. No. 19482.

Floods.

Forests and Their Influence on Floods (La Forêt et les Inondations). Paul Buffault. Reviews the literature of the subject, and gives the author's own views. 5200 w. Rev Gen d Sci—Nov. 15, 1910. No. 19613 D.

Harbor Bars.

Notes on the Bar Harbors at the Entrances to Coos Bay and Umpqua and Siuslaw Rivers, Oregon. Morton L. Tower. A study of this coast, showing that flood-tidal currents are an important factor in causing troublesome shoals at harbor entrances. Maps. 4000 w. Pro Am Soc of Civ Engrs—Nov., 1910. No. 19033 F.

Harbors.

River and Harbor Improvements and the Corps of Engineers. W. H. Bixby. Extracts from an address before the Nat. Rivers & Harbors Congress. 4000 w. Eng Rec—Dec. 24, 1910. No. 19564.

Improvements to the Port of Asuncion on the Paraguay River (Mededeelingen betreffende de Verbetering van de Rivierhaven te Asuncion en van de Paso de Tacumbu, Paraguay). J. F. Ligtenberg. Illustrated description of the harbor works and the regulation of the river. 9600 w. De Ingenieur—Nov. 12, 1910. No. 19844 D.

Hudson River.

The Character of the Hudson Gorge at New York City. G. S. Rogers. A study of the geology of the river bed, and of facts brought out by recent engineering works. Ills. 6000 w. Sch of Mines Qr —Nov., 1910. No. 19734 D.

Lock Gates.

Renewing Lock Gates on the Kanawha River. Thomas E. Jeffries. Illustrates and describes the method adopted and found satisfactory. 700 w. Eng Rec—Dec. 24, 1910. No. 19568.

The New Canal Gate at Sault Ste. Marie. Illustrates and describes the largest wooden gates thus far constructed in the U. S. The methods of fastening the wood and metal parts together have been given special attention. 1600 w. Eng Rec —Dec. 10, 1910. No. 19278.

Locks.

See Concrete, under CONSTRUCTION.

Marine Staging.

A Locomotive Stage. Illustrates and describes the Piercy locomotive stage that walks to its work. 1800 w. Sci Am—Dec. 10, 1910. No. 19245.

Messina.

Projects for the Rebuilding of the City and Harbor of Messina (Il Piano Regolatore della Citta e del Porto di Messina). A brief review of plans for repairing the damage done by the earthquake of 1908. Ills. 2800 w. Ann d Soc d Ing e d Arch Ital—Oct. 15, 1910. No. 19648 F.

Mississippi River.

The Deep Waterway from St. Louis to Cairo: A review of Seven Proposed Plans for Securing a Fourteen-Foot Waterway. J. W. Woermann. Map and description of the physical characteristics of this section of the Mississippi, with plans for the improvement. Ills. 6500 w. Jour Assn of Engng Socs. Nov., 1910. No. 19721 C.

Panama Canal.

The Panama Canal in 1910. Vaughan Cornish. Maps, plans and description of work on each of the three divisions, with general discussion. 10000 w. Jour Soc of Arts—Dec. 9, 1910. No. 19411 A.

Panama Canal in 1913. An interview with Mr. B. N. Baker, who considers that it will be possible to send a ship through the canal in 1913. 1200 w. Mfrs' Rec—Dec. 1, 1910. No. 19038.

Piers.

Reinforced-Concrete Piers at the U. S. Naval Station, Olongapo, Philippine Islands. C. A. Carlson. Illustrated detailed description of piers for berthing vessels of deep draft, having new features of interest. Construction is described. 4000 w. Eng News—Dec. 15, 1910. No. 19361.

River Regulation.

See Danube, under WATERWAYS AND HARBORS.

Water Powers.

Conservation of Water Powers of Canada. F. D. Monk. An address before the Caledonian Soc. on the work of the Conservation Commission. 3000 w. Can Elec News—Dec.. 1910. No. 19120.

A Proposed Platform of Principles Governing State and Federal Control of Water Power Development. Gives a plan drafted by Philip P. Wells. 1200 w. Eng News—Dec. 15, 1910. No. 19358.

Water Power Regulation in Pennsylvania. Farley Gannett. An account of the methods of supervising and granting of water power franchises which have been in use for five years. 1800 w. Eng Rec—Dec. 3, 1910. No. 19081.

ELECTRICAL ENGINEERING.

COMMUNICATION.

Fire Alarms.

New York Fire Alarm System. Information concerning the reconstruction of the system. Ills. 1800 w. Munic Jour & Engr—Dec. 21, 1910. No. 19507.

A New Fire-Alarm System. Brief illustrated description of the Reichel system. 600 w. Elec Rev, Lond—Dec. 9, 1910. No. 19421 A.

Radiotelegraphy.

The Periodicities and Damping Coefficients of Coupled Oscillators. John S. Stone. Read before Soc. of Wireless Tel. Engrs. Deduces expressions for the damping coefficients and periodicities of two coupled oscillators which will yield correct results in all practical cases. 2000 w. Elec Rev & W Elect'n—Dec. 3, 1910. No. 19098.

Submarine Cables.

Submarine Cable-Laying and Repairing. Charles Bright. Abstract of two lectures to the Royal Naval War College. Describes the work, types of cable used, and related matters. 1800 w. Elect'n, Lond —Dec. 9, 1910. Serial. 1st part. No. 19428 A.

A Proposed Cable Receiver Employing the Principle of Light Interference. Albert C. Crehore and George O. Squier. Explains reasons for suggesting a new form of cable receiver and describes the interference method. 1500 w. Elect'n, Lond—Dec. 9, 1910. No. 19427 A.

Submarine Cables for Long-Distance Telephone Circuits. W. A. J. O'Meara. Abstract of a paper read before the Inst. of Elec. Engrs. Describes early telephone cables, discussing the three methods of increasing the range, and describing the new Anglo-French cable, its laying and testing. Ills. 3000 w. Elect'n, Lond—Dec. 16, 1910. Serial. 1st part. No. 19582 A.

Telephone Cables.

See Submarine Cables, under COMMUNICATION.

Telephone Exchanges.

The Value of a Party-Line Lock-Out System in Reducing Depreciation of Telephone Exchanges. W. J. Miskella. Explains the advantages of the party-line lock-out system. 2000 w. Elec Rev & W Elect'n—Dec. 10, 1910. No. 19269.

Telephone Instruments.

Composite Artillery Type Telephone. Describes a telephone designed to operate either from a 30-volt central storage battery, or from two dry cells in each telephone. Ills. 1200 w. Jour U S Art—Nov.-Dec., 1910. No. 19553 D.

Telephone Rates.

Is a Rational Basis Possible for Telephone Rates? Dugald C. Jackson. Extracts from a paper before the Nat. Munic. League. Discusses the factors which should determine the rates, and gives the writer's methods of solving the problem. 3000 w. Eng News—Dec. 15, 1910. No. 19357.

Boston's New Telephone Rates. Ames G. Patterson. Describes the basis on which the telephone service in Boston and suburbs was being given, outlines the new plan, and gives an account of the work required in making the change. Ills. 5800 w. Harvard Engng Jour—Nov., 1910. No. 19756 D.

Telephony.

Researches on the Transmitter and on Long-Distance Telephony. Béla Gáti. Abstract of a paper read at the Int. Con. of European Telephone & Telegraph Administrations, Paris. Ills. 3300 w. Elec Rev & W Elect'n—Dec. 24, 1910. No. 19537.

DISTRIBUTION.

Current Rectifiers.

Mercury Arc Rectifiers. H. A. Cooch. Describes types and gives information concerning their efficiency. Ills. 2000 w. Ap Sci—Dec., 1910. No. 19725 C.

Fuses.

The Theory of Fuses (Zur Theorie der Schmelzsicherungen). E. Jasse. A detailed mathematical discussion. Ills. Serial. 1st part. 3300 w. Elektrotech u Maschinenbau—Nov. 20, 1910. No. 19829 D.

Tests of Diazed Fuses (Versuche mit elektrischen Schmelzsicherungen, bestehend aus Zweiteiligen Schraubstöpseln). Paul H. Perls. Gives results of official tests in Germany. Ills. 4000 w. Elek Kraft u Bahnen—Nov. 24, 1910. No. 19824 D.

DYNAMOS AND MOTORS.

A. C. Generators.

The Parallel Operation of Compound-Wound Alternators. R. L. Mossman. Illustrated article showing how a compound winding was changed to simple winding to make the machines work easily in parallel. 700 w. Power—Dec. 13, 1910. No. 19291.

Low-Speed Vertical Alternators (Alternateurs à Arbre Vertical à Faible Vitesse de Rotation). L. Legros. Describes recent direct-connected units built by the Oerlikon Company. Ills. Serial. 1st part. 2500 w. Bul Tech d l Suisse Romande—Nov. 10, 1910. No. 19635 D.

Some Characteristics of the Commutator Generator (Ueber einige Eigenschaften der Kommutatorgeneratoren). R. Van Cauwenberghe. Records some experiments with a shunt-wound single-phase commutator motor run as a generator. Ills. 3600 w. Elektrotech u Maschinenbau—Nov. 6, 1910. No. 19825 D.

A. C. Turbo-Generators.

See Turbine Tests, under MECHANICAL ENGINEERING, STEAM ENGINEERING.

Heating.

Check Calculation of the Heating in the Magnet Coils of Direct-Current Machines (Kontrollrechnung der Magnetspulen von Gleichstrommaschinen bezüglich Erwärmung). Thomas Rosskopf. Suggests a method differing from the usual practice. Ills. 2800 w. Elektrotech u Maschinenbau—Nov. 27, 1910. No. 19832 D.

Induction Motors.

Recent Developments in Induction Motor Design. An illustrated review of improvements introduced, and arrangements adopted by different makers. 2000 w. Elec Rev, Lond—Dec. 16, 1910. No. 19578 A.

Care and Maintenance of Induction Motors. R. H. Fenkhausen. Illustrated suggestions for the care of this type of motor. 1500 w. Power—Dec. 6, 1910. Serial. 1st part. No. 19138.

ELECTRO-CHEMISTRY.

Corrosion.

See Reinforced Concrete, under CIVIL ENGINEERING, MATERIALS OF CONSTRUCTION.

Electric Furnaces.

Temperature Drop, a True Measure of Thermal Resistance. Carl Hering. Aims to show that there exists an easily understood unit of thermal resistivity—a drop in temperature in degrees,—just as watts are a true measure of thermal conductivities. 2000 w. Met & Chem Engng—Dec., 1910. No. 19303 C.

Small Tubular Resistance Furnaces. Albert A. Somerville. Information concerning the construction and use of small furnaces of the electrical resistance type. Ills. 600 w. Elec Wld—Dec. 22, 1910. No. 19480.

The Electrometallurgy of Iron and Steel (Elektrische Eisen- und Stahlerzeugung). Dr. Juliusburger. Describes the new furnaces and installations of the Nathusius; Frick, Hiorth, and Ischewsky furnaces. 2000 w. Elek Kraft u Bahnen—Nov. 14, 1910. No. 19822 D.

Electrochemistry.

The Progress in Electrochemistry during 1906, 1907, and 1908 (Progrès de l'Electrochimie Technique pendant les Années 1906, 1907 et 1908). A detailed review of literature and patents covering the electrochemistry of metals. Ills. 7000 w. Rev d'Electrochimie—Oct., 1910. No. 19624 F.

Electrolytic Cells.

An Electrolytic Cell for Household Use. Charles F. Burgess. Illustrated description of a silver-cleaning apparatus, explaining its action. 1600 w. Wis Engr—Dec., 1910. No. 19518 C.

Electroplating.

Electro-Plating of Metals. Illustrates and describes methods of nickel-plating. 3000 w. Sci Am Sup—Dec. 24, 1910. No. 19492.

An Electrolytic Galvanizing Apparatus (Vorrichtung zum elektrolytischen Galvanisieren von Wassenartikeln). G. J.

Roman. Describes an apparatus for electroplating small articles. Ills. 1500 w. Galvan u Metal—Nov., 1910. No. 19663 D.

Organic Substances.

The Electrochemistry of Organic Substances from 1907 to 1910 (L'Electrochimie des Corps organiques, résumé de 1907 a 1910). A. Gerngross. A review of the literature of the subject. Serial. 1st part. 2000 w. Rev d'Electrochimie—Aug.-Sept., 1910. No. 19623 F.

ELECTRO-PHYSICS.

Alternating Currents.

Generating Alternating Currents of Any Frequency. Dr. Alfred Gradenwitz. Explains a scheme for utilizing periodic fluctuations, generated by artificial means, for the generation of alternating currents. 1200 w. Elec Rev, Lond—Dec. 2, 1910. No. 19312 A.

Crest Factors and Form Factors of Symmetric Periodic Curves. W. C. Clinton. Gives general expressions of the crest factor and form factor of periodic functions in terms of the harmonics. 1000 w. Elect'n, Lond—Nov. 25, 1910. No. 19184 A.

Eddy Currents.

Eddy Currents in Massive Conductors in Slots (Wirbelstromverlauf in massiven, in Nuten eingebetteten Leitern). Herr Angermann. A mathematical investigation of a rectangular conductor completely filling a slot. Ills. 3200 w. Elektrotech u Maschinenbau—Nov. 13, 1910. No. 19826 D.

Magnetism.

Usual Statement of Laws of Magnetic Attraction May Mislead. Carl Hering. A critical discussion of the inverse square law of magnetic attraction. Also editorial note. 1600 w. Elec Rev. & W Elect'n—Dec. 10, 1910. No. 19267.

The Magnetic Properties of Iron and Its Alloys in Intense Fields. Sir Robert A. Hatfield, and Prof. B. Hopkinson. Gives a summary of results thus far obtained in an examination of a series of alloys, describing the apparatus. Ills. 12700 w. Inst of Elec Engrs—Dec., 1910. No. 19426 N.

Magnets.

See Alloys, under MECHANICAL ENGINEERING, MATERIALS OF CONSTRUCTION.

GENERATING STATIONS.

Accumulators.

The 1910 Edison Storage Battery. Walter E. Holland. Abstract of a paper read before the Assn. of Edison Ill. Co.'s. Describes methods of testing and presents results of tests. 3500 w. Elec Rev & W Elect'n—Dec. 3, 1910. No. 19097.

See also Electric, under MECHANICAL ENGINEERING, AUTOMOBILES; Wind Power, under MECHANICAL ENGINEERING, POWER AND TRANSMISSION.

Central Stations.

Station of the Empire District Electric Company. M. R. Bump. Illustrated description of a steam turbine plant equipped for storing coal under water and operating in parallel with hydroelectric and gas-engine stations, to supply electrical energy to the lead and zinc mines of the Joplin district of Missouri, Kansas and Oklahoma. 1500 w. Elec Wld—Dec. 1, 1910. No. 19047.

The Randfontein Gold-Mines Power-Station. Illustrated description of a central station in the Transvaal to furnish power for a group of mines. 1500 w. Engng—Nov. 25, 1910. No. 19193 A.

Swedish Generating Station. E. Andreason. Illustrated description of the extension of the municipal steam electric power station of Stockholm. 2500 w. Elec Wld—Dec. 8, 1910. No. 19226.

The Electric Installations of the Metropolitan of Paris (Les Installations électriques du Chemin de Fer Métropolitain de Paris). J. Quinat. A detailed description of the generating and transmitting equipment. Ills. Serial. 1st part. 6300 w. Génie Civil—Nov. 5, 1910. No. 19638 D.

See also Refuse Destructors, under CIVIL ENGINEERING, MUNICIPAL.

Economics.

Central-Station Heating to Conserve the Natural Resources. F. H. Stevens. Explains the advantages and economy of central-station heating. 1500 w. Elec Wld—Dec. 8, 1910. No. 19229.

Hydro-Electric.

The Water-Power Industry of Sweden (Die Wasserkraftindustrie Schwedens). Sven Lübeck. A brief review of its development and present status. 5000 w. Die Turbine—Nov. 5, 1910. No. 19696 D.

Hydro-Electric Practice. H. A. von Schon. The importance of accurate determination of the precipitation and run-off in determining the commercial value of an undertaking. 2200 w. Munic Engng—Dec., 1910. No. 19730 C.

The Design of Water-Power Plants (Zur Behandlung der Bauformen Kleinerer Wasserkraftanlagen). C. Reindl. Discusses the aesthetic side of the design of buildings to house hydro-electric machinery. Ills. 2000 w. Zeitschr f d Gesamte Turbinenwesen—Nov. 10, 1910. No. 19800 D.

Low-Head Hydroelectric Development. Brief illustrated description of the new 10,000-kw. power station of Chippewa Railway, Light, & Power Co. at Cedar Falls, Wis. 2000 w. Elec Wld—Dec. 22, 1910. No. 19478.

Interconnected Electrical Transmission System. Illustrated description of the hydraulic installation of the Central Maine Power Company, utilizing the Kennebec River. 2000 w. Elec Wld—Dec. 15, 1910. No. 19350.

Hydroelectric Development at San Juancito, Honduras. Gives general arrangement of machines, and turbine details in the station, describing a development to supply power for mining. 1200 w. Eng Rec—Dec. 17, 1910. No. 19391.

The Hydro-Electric Power Plant on the Jhelum River in Kashmir, India. Heinrich Homberger. Gives the history of the project and illustrated description of the development. 5000 w. Jour Assn of Engng Socs—Nov., 1910. No. 19722 C.

The Ventavon Hydroelectric Plant. C. L. Durand. Illustrated description of a modern 30000 h.p. plant in France. 2500 w. Elec Rev & W Elect'n—Dec. 10, 1910. No. 19266.

The Beswitz Hydro-Electric Plant (Usine hydraulico-electrique de Beswitz, Allemagne). H. Marchand. Describes a plant in Germany intended to supply energy for agricultural purposes. 2000 w. L'Elecn—Nov. 26, 1910. No. 19634 D.

Isolated Plants.

Western Union Plant in Chicago. Osborn Monnett. Illustrates and describes the mechanical equipment furnishing power for a system of independent electric drives in connection with all the machines of a large printing establishment. 1200 w. Power—Dec. 20, 1910. No. 19457.

Power-Requirement Determination in the Design of a Railway-Shop Power Plant (Zur Berechnung des Kraftwerkes für eine Eisenbahnhauptwerkstatt: Versuche über Grösse und Wechsel des Kraftbedarfes). Bruno Schwarze. Detailed explanation of methods of determining the maximum power demand and the probable variations in demand. Ills. 3800 w. Elek Kraft u Bahnen—Nov. 24, 1910. No. 19823 D.

See also Turbine Plants, under MECHANICAL ENGINEERING, STEAM ENGINEERING.

Italy.

The Principal Generating Stations in Italy (I Principali Impianti Electrici d'Italia). A review of the recent vast development of the electricity supply industry. 4600 w. Monit Tech—Nov. 10, 1910. No. 19653 D.

Power Factor.

The Power Factor of a Three-Phase System (Der Leistungsfaktor eines Drehstromsystems). F. Niethammer. Mathematical discussion of the proper definition of the power factor of a system with unequally loaded phases. Ills. 1800 w. Elektrotech u Maschinenbau—Nov. 27, 1910. No. 19833 D.

Rates.

How Hydroelectric Energy Displaces Coal. Alton D. Adams. Discusses the amount and price of sales of energy made by various hydroelectric systems to consumers. Editorial note. 3000 w. Elec Wld—Dec. 1, 1910. No. 19048.

The Rate Question. H. C. Abell. Comments on recently published articles discussing rates, giving the author's opinions. 1000 w. Elec Wld—Dec. 22, 1910. No. 19481.

The History and Economics of Central Station Rate Making. M. D. Cooper. Brief review of the history of rate making. 3500 w. Wis Engr—Dec., 1910. No. 19517 C.

Central-Station Rates (Zur Tariffrage). Kasimir Gajczak. Discusses certain features of the rate-making problem. Ills. 2000 w. Elektrotech u Maschinenbau—Nov. 20, 1910. No. 19830 D.

Switchgear.

See Electric Power, under MINING AND METALLURGY, COAL AND COKE.

LIGHTING.

Arc Lamps.

Three-Phase Arcs with Four Carbons. L. Crouch. Explains the good results recently obtained by Righi by the use of four carbons. Ills. 800 w. Elec Rev, Lond—Dec. 9, 1910. No. 19420 A.

Illumination.

The New Era in Electrical Illumination. Rollin W. Hutchinson, Jr. This second article of a series deals with flaming, luminous-arc and vapor lamps. Ills. 3500 w. Engineering Magazine—Jan., 1911. No. 19741 B.

Some Practical Observations on Illumination. A. G. Rakestraw. Deals with different kinds of illuminants, and their application. 2500 w. Sib Jour of Engng—Nov., 1910. Serial. 1st part. No. 19020 C.

Graphical Solution of Problems Involving Plane-Surface Lighting Sources. A. S. McAllister. Explains the graphical solution and outlines the proof of its accuracy. Also editorial note. 3300 w. Elec Wld—Dec. 8, 1910. No. 19227.

Indirect Lighting of Churches. Brief illustrated description of a model installation at Rome, N. Y. 600 w. Elec Rev & W Elect'n—Dec. 24, 1910. No. 19536.

Notes on Drafting Room Lighting. C. E. Clewell. Includes experiments for determining intensity and the arrangement and number of lamps required. Ills. 2000 w. Elec Jour—Dec., 1910. No. 19514.

The Mazda Lamp with a Few Common Types of Reflectors. R. Horatio Wright. Illustrated article showing the effect of light distribution by the use of different reflectors. 1500 w. Sib Jour of Engng—Nov., 1910. No. 19021 C.

The Lighting of the Allegheny County Soldiers' Memorial. Bassett Jones, Jr. Abstract of a paper before the N. Y. Sec. of the Ill. Engng. Soc. Illustrates and describes the architectural features and illuminating equipment of a beautiful building in Pittsburgh. Colored screens and colored illuminants are used. Also editorial. 3000 w. Elec Wld—Dec. 15, 1910. No. 19353.

Electrical Equipment of the Landau Municipal Auditorium (Die technischen Einrichtungen der städtischen Festhalle in Landau). Julius Weil. The first part describes the illumination of the great hall. Ills. Serial. 1st part. 2000 w. Elektrotech Rundschau—Nov. 10, 1910. No. 19818 D.

Incandescent Lamps.

The Metal Lamp Filament. Dr. H. F. Baumhauer. Trans. from *Zeit. fuer Angewandte Chemie.* Describes their manufacture. 2500 w. Sci Am Sup—Dec. 24, 1910. No. 19491.

Mercury-Vapor Lamps.

See Vacuum Tubes, under LIGHTING.

Military Signals.

An Improved Ardois. Paul D. Bunker. Describes a system for quick and efficient night signaling. Ills. 1500 w. Jour U S Art—Nov.-Dec., 1910. No. 19552 D.

Reflectors.

The Cooper Hewitt Light-Transforming Reflector. Joseph B. Baker. Explains the application of this reflector to vacuum tubes and to incandescent lamps, describing results. 1500 w. Sci Am—Dec. 24, 1910. No. 19490.

Street.

Street Lighting by Modern Electric Lamps. Haydn T. Harrison. Gives details of street lighting of St. Marylebone, where incandescent gas lamps have been replaced with metal filament lamps, discussing efficiency, equitable charge, etc. 8500 w. Inst of Elec Engrs—Nov. 24, 1910. No. 19181 N.

Public Lighting in the City of London. Reviews the history of electric lighting in London and describes the schemes recently put in operation. Ills. 4000 w. Elect'n, Lond—Dec. 16. 1910. Serial. 1st part. No. 19581 A.

Street-Lighting Costs. C. Toone. On the costs of running and upkeep of various electric street lamps. 1200 w. Elec Rev, Lond—Nov. 25, 1910. Serial. 1st part. No. 19179 A.

Arc Lamp-Posts of New York. Illustrates and describes details of the ornamental standards used. 2500 w. Elec Wld—Dec. 8, 1910. No. 19230.

Mercury-Vapor Quartz Lamps. Maurice Leblanc, Jr. Abstract trans. from *La Lumière Elec.* Describes these lamps and their high efficiency, and gives information relating to them. 2000 w. Elec Rev & W Elect'n—Dec. 17, 1910. No. 19404.

MEASUREMENT.

Cable Testing.

Tests of an Underground Transmission System after Installation (Essais des Canalisations Souterraines après Pose). M. Armagnat. Describes methods and apparatus used. Ills. 5400 w. Bul Soc Int d Elecns—Nov., 1910. No. 19608 F.

See also Cables, under TRANSMISSION.

Capacity.

See Insulation Testing, under MEASUREMENT.

Dynamo Testing.

A Comparison of Three Methods of Measuring the Efficiency of Direct-Current Machines (Comparaison de Trois Méthodes de Mesure du Rendement des Machines à Courant Continu). A report of comparative results of the Swinburne, Kapp, and Fontaine and Cardew methods. Ills. 2000 w. Soc Belge d'Elecns—Oct., 1910. No. 19605 E.

Frequency.

Frequency Meters. Dr. O. Martienssen. Abstract of an article in *Elek. Kraftbetriebe und Bahnen.* Describes some well-known types severally depending on totally distinct principles. 1000 w. Elect'n, Lond—Nov. 25, 1910. No. 19183 A.

Insulation Testing.

The Theory of Insulation Testing and Capacity Measurement in Plants under Operation (Die Theorie der Isolations- und Kapazitätsmessungen an Anlagen im Betrieb). H. Hausrath. A detailed theoretical description of methods. Ills. Serial. 1st part. 4000 w. Elektrotech u Maschinenbau—Nov. 13, 1910. No. 19828 D.

Laboratories.

The High-Tension Laboratory at the Danzig Technical High School (Das Hochspannungslaboratorium des Elektrotechnischen Instituts der Technischen Hochschule in Danzig). G. Roessler. Illustrated description of the equipment. 5600 w. Zeitschr d Ver Deutscher Ing—Nov. 12, 1910. No. 19839 D.

Magnetic Flux.

A New Method of Measuring the Strength of Magnetic Fields. Prof. W. Bukert. Abstract of an article in the *Elektrotechnische Zeit.* Describes a method depending on the Hall effect, which is especially noticeable in bismuth, which is used. 400 w. Elect'n, Lond—Nov. 25, 1910. No. 19182 A.

Resistance.

The Direct Measurement of High Resistance by a Megger. Arthur J. Rowland. Illustrated description of an instrument of the permanent-magnet-moving-coil type, and its use. 1500 w. Cent Sta—Dec., 1910. No. 19280.

Measurement of Self-Inductance and Effective Resistance at High Frequencies. Charles E. Hay. Describes a method devised and used by the writer. 500 w. Elec Rev, Lond—Dec. 9, 1910. No. 19425 A.

Resistance Standards.

A New Form of Non-Inductive Low-Resistance Standard, or Shunt. Dr. C. V. Drysdale. The resistance described is made by cutting the electrodes into a number of thin strips which intercalate with one another, reducing the inductance to a very small figure. Ills. 1000 w. Elect'n, Lond—Dec. 9, 1910. No. 19429 A.

POWER APPLICATIONS.

Heating.

The Present Position of Electric Heating and Cooking. Gives a summary of replies to questions sent to station engineers. Also editorial. 8500 w. Elect'n, Lond—Dec. 2, 1910. No. 19313 A.

Electric Hot-Water Supply System. Joseph B. Baker. Illustrated description of an electric heat storage system for supplying electrically heated water in considerable quantities. 1000 w. Sci Am—Dec. 3, 1910. No. 19100.

Pumping.

See Pumping Plants, under MECHANICAL ENGINEERING, HYDRAULIC MACHINERY.

Tanning.

Electricity in the Tanning Industry. Illustrated description of an installation of more than usual interest in a tannery at Kenosha, Wis. 2000 w. Elec Rev & W Elect'n—Dec. 3, 1910. No. 19096.

Turn Tables.

See same title, under RAILWAY ENGINEERING, PERMANENT WAY AND BUILDINGS.

TRANSMISSION.

Alternating Currents.

Currents in Delta-Connected Circuits. B. F. Jacobsen. Investigates the relation which exists between line currents as measured by the switchboard instruments and the currents in each phase of the delta-connected generator. 1000 w. Elec Wld—Dec. 15, 1910. No. 19351.

Solution of Problems in Star-Connected Unbalanced Three-Phase Circuits. Chesley H. Johnson. Treats of the vector diagrams of unbalanced star loads of known impedance connected to a given delta triangle of three-phase line voltages. 1500 w. Elec Wld—Dec. 15, 1910. No. 19352.

Cables.

Discussion on "Potential Stresses in Dielectrics." New York, October 17, 1910. Discussion on paper by Harold S. Osborne and Harold Pender. 13500 w. Pro Am Inst of Elec Engrs—Dec., 1910. No. 19712 F.

Cable Tests at the Central Electrical Laboratory, Paris (Essais de Cables pour Canalisations électriques effectués au Laboratoire central d'Electricité). Ch. David. Reports an investigation of electric cables for use in the French Navy, covering the effects of bending, the effects of heat on the insulation, and the heating of cables by the current. Ills. 18000 w. Bul Soc Int d Elecns—Oct., 1910. No. 19607 F.

The Specifications of the Union des Syndicats for Lead-Covered Cables for Tensions above 2,000 Volts (Observations sur le Cahier des Charges de l'Union des Syndicats, relatif aux Cables sous Plomb armés, pour Tensions supérieures à 2,000 Volts). M. Grosselin. Gives the text of the specifications and a discussion of the terms. Ills. 5000 w. Bull Soc Int d Elecns—Nov., 1910. No. 19609 F.

See also Cable Testing, under MEASUREMENT; and Electric Power, under MINING AND METALLURGY, COAL AND COKE.

Economics.

The Calculation of the Maximum Economy of an Electrical Transmission System (La Calcolazione di Massimo Tornaconto delle Linee per Trasmissione Elettrica di Energia). Giacinto Motta. A mathematical discussion of transmission-line repairs, depreciation, amortization, energy losses, etc. Ills. Serial. 1st part. 3000 w. Monit Tech—Nov. 10, 1910. No. 19651 D.

Grounding.

Some Notes on Ground Connections. Edgar H. Holmes. Describes some methods of making ground connections and gives some performance data. Ills. 1500 w. Elec Wld—Dec. 1, 1910. No. 19049.

Lines.

See Central Stations, under GENERATING STATIONS.

Line Terminals.

Brick Tower Terminals for Overhead Lines. Drawings and description, explaining advantages. 1200 w. Elec Engr, Lond—Nov. 25, 1910. No. 19176 A.

Regulations.

The French Law of March 21, 1910, and the Regulations of the Union des Syndicats (Quelques Remarques à Propos de l'Arrêté du 21 Mars 1910 et des Instructions de l'Union des Syndicats). M. Boucherot. Discusses the new French regulations relative to safety devices on transmission lines, and the specifications of the Union des Syndicats relative to the acceptance and installation of transformers. Ills. 5200 w. Bul Soc Int d Elecns—Nov., 1910. No. 19610 F.

Some Points in Connection with Transformers. Considers the transformer from the viewpoint of the operating engineer. 2200 w. Elec Rev, Lond—Dec. 9, 1910. No. 19422 A.

Single Phase Transformer Connections. Norman G. Meade. Diagrams and explanations. 1000 w. Power—Dec. 27, 1910. No. 19575.

Problems in the Operation of Transformers. F. C. Green. Considers the selecting of transformers designed to meet the service requirements, the installing, causes of failures, care in operating, connections, etc. 4000 w. Pro Am Inst of Elec Engrs—Dec., 1910. No. 19711 F.

See also Regulations, under TRANSMISSION.

Voltage Regulation.

Modern Induction Regulators, Their Usages and Results. F. W. Shackelford.

Illustrates and describes apparatus made by the General Electric Company. 1800 w. Elec Rev & W Elect'n—Dec. 24, 1910. No. 19535.

Wires.

Electrical Properties of Compound Wires. Frank F. Fowle. Information concerning recent improvements in their construction, and the usefulness of copper-clad steel wires, and gives results of a study of their electrical properties. 2500 w. Elec Wld—Dec. 22, 1910. No. 19479.

MISCELLANY.

Canada.

Openings for Electrical Enterprises in the Canadian Northwest. Explains the important part electricity will assume in the development of the country, suggesting places where its development is of immediate importance. 2500 w. Elec Rev, Lond—Nov. 25, 1910. No. 19180 A.

Copper.

The Electrical Conductivity of Commercial Copper. F. A. Wolff and J. H. Dellinger. Abstract of a paper to appear in Bul. of Bureau of Standards. Experimental investigation and results of tests made to furnish data to be used in establishing more reliable standard values. 4000 w. Pro Am Inst of Elec Engrs—Dec., 1910. No. 19713 F.

The Temperature Coefficient of Resistance of Copper. J. H. Dellinger. Abstract of a paper to appear in Bul. of Bureau of Standards. A report of investigations. 4000 w. Pro Am Inst of Elec Engrs—Dec., 1910. No. 19714 F.

Exhibitions.

Electricity at the Brussels Exposition (Die Elektrotechnik auf der Weltausstellung in Brüssel 1910). Herr Hentschel. A review of the electrical exhibits. Ills. Serial. 1st part. 3200 w. Glasers Ann—Nov. 15, 1910. No. 19808 D.

Industry.

What's Wrong with the Electrical Industry? H. A. Carney. Read before the Manchester Students' Section of I. E. E. Discusses some of the causes given to explain the unsatisfactory condition of the industry in England, and how to put it right. 5000 w. Elec Engr, Lond—Dec. 9, 1910. No. 19418 A.

INDUSTRIAL ECONOMY.

Accounting.

The Balance Sheet (Le Bilan dans l'Industrie). Maurice Bellom. Discusses the desiderata in a balance sheet in industrial accounting and the means of attainment. 2800 w. Génie Civil—Nov. 26, 1910. No. 19645 D.

Apprenticeship.

The Revival of Apprenticeship. G. Basil Barham. Discusses the question in its relation to the electrical industry. 2000 w. Elec Rev, Lond—Dec. 9, 1910. No. 19423 A.

Apprenticeship System of the Lehigh Valley at the Sayre Shops. R. A. Hunt. Brief description. 800 w. Ry Age Gaz—Dec. 2, 1910. No. 19117.

The Crisis of Apprenticeship (La Crise de l'Apprentissage). E. Bertin. A study of present conditions in France, with suggestions for remedies. 4000 w. Tech Mod—Nov., 1910. No. 19621 D.

Technical Apprentice Courses and Preapprenticeship Courses (Cours Techniques d'Apprentis et Cours de Préapprentissage). . A. Jully. Discusses conditions in engineering and industrial education in France and offers suggestions for their improvement. 6500 w. Bul Soc d'Encour—Nov., 1910. No. 19629 G.

Argentina.

Argentina from a British Point of View. Campbell P. Ogilvie. Information concerning the country, its industries trade, etc. 7500 w. Jour Soc of Arts—Dec. 2, 1910. No. 19307 A.

Cost Systems.

The Various Elements of Cost. Holden A. Evans. Considers the importance of accuracy in obtaining direct labor charges, material charges, indirect cost, depreciation, etc. 5500 w. Am Mach—Vol. 33. No. 49. No. 19211.

Depreciation.

Determining Amortization in Industrial Plants (De l'Allure de l'Amortissement industriel). Maurice Bellom. A mathematical study of the method of calculating the annual amortization. Ills. 4500 w. Tech Mod—Nov., 1910. No. 19622 D.

See also Public Utilities, under INDUSTRIAL ECONOMY.

Education.

Legislation Upon Industrial Education in the United States. Prepared by Edward C. Elliott and C. A. Prosser. 18000 w. Nat Soc for Pro of Ind Ed—Bul. No. 12. No. 19494 N.

Limitations of Efficiency in Engineering Education. George Fillmore Swain. Extracts from an address at Union College, Schenectady. Considers what an engineering graduate should be, some of the difficulties met, and suggests remedies. 6500 w. Eng Rec—Dec. 17, 1910. No. 19390.

Commercial Training of the Engineer. E. Kilburn Scott. Gives the main heads of a syllabus drawn up by the author for a course on Quantities and Estimates, explaining methods. 2000 w. Elec Engr, Lond—Dec. 9, 1910. No. 19417 A.

The Production of Foundrymen. John Jermain Porter. Explains the methods of foundry instruction in the co-operative engineering course of the University of Cincinnati. 1500 w. Am Brass Found Assn—1910. No. 19014 N.

The Educational Bureau of the Union Pacific Railroad. Dexter C. Buell. An account of the work undertaken to increase the efficiency of railway officials and employees. Also discussion. 12800 w. Pro Cent Ry Club—Nov. 11, 1910. No. 19752 C.

The Mechanical Specialist, Coast Artillery Corps. Offnere Hope. Explains the aim and scope of the education given to engineers and firemen. Ills. 3500 w. Jour U S Art—Nov.-Dec., 1910. No. 19550 D.

The Industrial Training of Boys. J. J. Flather. Read before the Nat. Founders' Assn. Discusses the education and the development of the apprentice. 3500 w. Ir Age—Dec. 8, 1910. Serial. 1st part. No. 19224.

German and American Trade Schools. Paul Kreuzpointner. Considers the German system and the reasons for its success. 2500 w. Am Mach—Vol. 33. No. 50. No. 19349.

The Organization of Technical High Schools (Zur Organisation der Technischen Hochschulen). Cornelius Gurlitt. A discussion of conditions in engineering education in Germany. Serial. 1st part. 3300 w. Deutsche Bau—Nov. 23, 1910. No. 19691 B.

The Opening of the Breslau Technical High School (Zur Eröffnung der Technischen Hochschule in Breslau). Describes the laboratory equipment. Ills. 2000 w. Stahl u Eisen—Nov. 30, 1910. No. 19675 D.

See also Laboratories, under MECHANICAL ENGINEERING, HYDRAULIC MACHINERY.

Engineering.

Influence of Pure Science in Engineering. Sir J. J. Thomson. Pres. address before the Jun. Inst. of Engrs. 4000 w. Elec Engr, Lond—Nov. 25 1910. No. 19178 A.

Some Mistakes of an Unsuccessful Engineer. A report of mistakes in dealing with men which will be of interest to young engineers. 6000 w. Eng News—Dec. 22 1910. No. 19483.

Exhibitions.

The Turin Exhibition. Illustrations and information in regard to the international exhibition to be opened in April to commemorate the fiftieth anniversary of the foundation of the Kingdom of Italy. 2000 w. Engr, Lond—Dec. 16, 1910. No. 19701 A.

Industrial Accidents.

See Accidents, under MINING AND METALLURGY, MINING.

Labor Agreements.

The Shipbuilding Workers' Agreement. Editorial discussion. 3000 w. Engng—Dec. 16, 1910. No. 19597 A.

Labor Legislation.

Significance of Legislative Records. Marshall Cushing. Read before the Nat. Found. Assn. Discusses Congressional action on labor questions and the bearing of recent election results on possible labor laws. 4500 w. Ir Trd Rev—Dec. 1, 1910. No. 19059.

Management.

The Twelve Principles of Efficiency. Harrington T. Emerson. This eighth article of a series discusses the sixth principle: reliable, immediate and adequate records. 3500 w. Engineering Magazine—Jan., 1911. No. 19740 B.

Systematic Foundry Operation and Foundry Costs. C. E. Knoeppel. This fourth article of a series discusses production and the control of productive operations. 3500 w. Engineering Magazine—Jan., 1911. No. 19744 B.

Foundry and Machine Shop Agreement. Walter J. May. Suggestions for securing economy in the total cost of any article. 1000 w. Prac Engr—Dec. 16, 1910. No. 19584 A.

Graphical Charts in Factory Management (Graphische Statistik im Dienste der Fabrikorganisation). C. M. Lewin. Shows the value and methods of graphical representation of industrial statistics. Ills. 4000 w. Zeitschr f Werkzeug—Nov. 15, 1910. No. 19816 D.

Monopoly.

Monopoly and Progress. Dr. Franz Erich Junge-Hermsdorf. A brief résumé of the history of public lands and resources in the United States as the foundation of private monopoly power. First of three articles. 3000 w. Engineering Magazine—Jan., 1911. No. 19739 B.

Public Utilities.

Valuation of Public Utilities. Clinton S. Burns. Discusses depreciation and present value, deducing formulae, and explaining a new method of appraisement. 3000 w. Munic Jour & Engr—Nov. 30, 1910. No. 19061.

The Valuation of Public Service Corporation Property. Henry Earle Riggs. Considers the reasons for requiring such valuations, and discusses the methods which should be used in arriving at a correct cost of reproduction and depreciation. 60000 w. Pro Am Soc of Civ Engrs—Nov., 1910. No. 19035 F.

Wage Systems.

An Innovation in Wage Scales. Albert Halstead. Brief account of a new rate of wages soon to become operative in England under which workers will be graded according to their qualifications and capacity. 1200 w. Am Mach—Vol. 33. No. 50. No. 19346.

MARINE AND NAVAL ENGINEERING.

Ammunition.

The Stability of Smokeless Powder. J. Strauss. A study of the duration of powder in a safe condition and its testing. Also general discussion. 10000 w. Pro U S Nav Inst—Dec., 1910. No. 19548 E.

Battleships.

Dreadnoughts—What Are They? Sidney Graves Koon. Illustrated discussion of these vessels as the most advanced battleship types. 5000 w. Engineering Magazine—Jan., 1911. No. 19742 B.

Notes on the Armaments of Battleships. Sir William H. White. A summary of the principles which shall regulate the armaments of modern battleships, with a review of present practice and tendencies. 8000 w. Soc of Nav Archts & Marine Engrs, No. 1—Nov. 17, 1910. No. 19460 N.

The Armament of Battleships. Editorial review of Sir William White's paper on this subject, read before the Soc. of Nav. Archts. & Marine Engrs. in New York. 2500 w. Engr, Lond—Dec. 2, 1910. No. 19333 A.

Four Recent Types of Dreadnoughts. Digest of a paper by Luigi Barberis, translated from *Rivista Marittima*. The four ships are the Russian "Sebastopol" class of four ships; the American "Wyoming" and "Arkansas;" the Argentine "Rivadavia" and "Moreno;" and the French "Jean Bart" and "Courbet." Ills. 1500 w. Sci Am—Dec. 24, 1910. No. 19487.

An Analysis of Tests of Water-Tight Bulkheads with Practical Rules and Tables for Their Construction. William Havgaard. A continuation of a paper read one year ago. Further develops the theory advanced and gives an analysis of tests, with practical rules and tables. Ills. 7000 w. Soc of Nav Archts & Marine Engrs, No. 7—Nov. 17, 1910. No. 19466 N.

Colliers.

Coaling Warships—Notes of Progress. Spencer Miller. An illustrated paper describing the colliers and the coal-discharging gear. 5000 w. Soc of Nav Archts & Marine Engrs, No. 4—Nov. 17, 1910. No. 19463 N.

Cruisers.

The Cruiser Dixie; Tender to the Atlantic Torpedo Fleet. Paul Foley. Illustrated description of a repair and supply vessel to accompany a battleship fleet. 3000 w. Jour Am Soc of Nav Engrs—Nov., 1910. No. 19031 H.

Destroyers.

Comparative Performance Data of Recent Destroyers. David F. Boyd. A report of recent trials and results, with matters related. 4000 w. Jour Am Soc of Nav Engrs—Nov., 1910. No. 19024 H.

Description and Trials of Torpedo-Boat Destroyers Paulding and Drayton. H. C. Dinger. Illustrated description with report of trials. 10000 w. Jour Am Soc of Nav Engrs—Nov., 1910. No. 19030 H.

Electric Power.

See Cables, under ELECTRICAL ENGINEERING, TRANSMISSION.

Evaporators.

Test of an Evaporator. S. M. Robinson. An account of tests made to determine the cost of evaporation and the advantages of operating under different conditions. Ills. 1200 w. Jour Am Soc of Nav Engrs—Nov., 1910. No. 19027 H.

Fire Prevention.

Some Suggestions for Reducing the Loss by Fire on Vessels. Samuel D. McComb. Suggestions applying to wooden as well as steel vessels, and to small as well as large ones. 7000 w. Soc of Nav Archts & Marine Engrs, No. 11—Nov. 17, 1910. No. 19469 N.

Gas Engines.

Two Marine Installations of Producer Gas. Charles B. Page. Describes the installations on the "Mary A. Sharp," and on the "Superior," commercial vessels powered with producer gas. Ills. 2000 w. Soc of Nav Archts & Marine Engrs, No. 12—Nov. 17, 1910. No. 19470 N.

Gyroscope.

The Gyroscope for Marine Purposes. Elmer A. Sperry. Discusses the principal uses of the gyroscope at sea. Ills. 5000 w. Soc of Nav Archts & Marine Engrs, No. 9—Nov. 17, 1910. No. 19468 N.

Naval Engieering.

Naval Engineering Progress. H. I Cone. A lecture before the U. S. Naval War College. Reviews developments of the past year in naval engineering, particularly those affecting strategy and tactics. 7000 w. Jour Am Soc of Nav Engrs—Nov., 1910. No. 19023 H.

Propellers.

Evolution of Screw Propulsion in the United States. Charles H. Cramp. The second part of a review of screw propulsion, covering the time from 1849. Ills. 2500 w. Soc of Nav Archts & Marine Engrs, No. 2—Nov. 17, 1910. No. 19461 N.

Revolution Indicator.

The McNab Marine Revolution Indicator. Illustrated description of an instrument which enables the revolutions of the main engines of a steamship to be indicated on the bridge or in the chart-house. 1000 w. Engng—Dec. 9, 1910. No. 19442 A.

Salving.

Army Plan for Uncovering the "Maine." Illustrated, with brief description. 900 w. Sci Am—Dec. 24, 1910. No. 19488.

Scows.

A 3000-Yard Steel Dump Scow. Interesting features in the design and methods of construction are described. 2000 w. Eng Rec—Dec. 17, 1910. No. 19386.

Ship Design.

The Block Coefficient. P. A. Hillhouse. Gives definitions and use of the block coefficient, methods of calculating, and formulae. 2000 w. Inst of Engrs & Shipbldrs in Scotland—Oct. 25, 1910. No. 19771 N.

The Isherwood System of Ship Construction (Das Isherwoodsystem). G. Buchsbaum. Describes and discusses a number of vessels built on this system. Ills. Serial. 1st part. 2200 w. Schiffbau—Nov. 9, 1910. No. 19685 D.

Ship's Rolling.

Tanks for Preventing the Rolling of Ships. Editorial discussion of Mr. Frahm's researches. 1600 w. Engng—Dec. 16, 1910. No. 19598 A.

Steamboats.

The Paddle Steamer Weeroona. Illustrates and describes this high-speed passenger vessel, recently completed, for tourist day-traffic on Port Philip Bay, Australia. 1500 w. Engr, Lond—Dec. 9, 1910. No. 19448 A.

Steam Boilers.

Report of Test of a Babcock & Wilcox Boiler for U. S. Battleships Wyoming and Arkansas. With notes by H. C. Dinger. Gives data from the report of the Board of Naval Officers. 3300 w. Jour Am Soc of Nav Engrs—Nov., 1910. No. 19029 H.

Steam Engines.

The Practical Operation of Steam Turbines and Reciprocating Engines. Francis J. S. Nolan. Describes in detail the work necessary to overhaul reciprocating engines, comparing with turbines. 2500 w. Int Marine Engng—Dec., 1910. No. 19206 C.

The Economical Working of Reciprocating Marine Engines and Their Auxiliaries. D. B. Morison. Read before the N.-E. Coast Inst of Engrs. & Shipbldrs. Reviews the system on which main engines and their auxiliaries are worked with the aim of determining the best methods for commercial results. 5000 w. Engng—Dec. 2, 1910. Serial. 1st part. No. 19329 A.

Comparative Results in Steam and Coal Consumption with Turbines, Reciprocating Engines and a Combination of the Two on the Steam Yacht Vanadis. Clinton H. Crane. Describes tests and results. 2500 w. Soc of Nav Archts & Marine Engrs, No. 8—Nov. 17, 1910. No. 19467 N.

The German Naval Architects. Reports the meeting at Charlottenburg of the Schiffbautechnische Gesellschaft. The present number gives Prof. Stumpf's paper on "The Further Development of the Uni-flow Steam Engine," with discussion. 3500 w. Engr, Lond—Nov. 25, 1910. Serial. 1st part. No. 19196 A.

See also Air Pumps, under MECHANICAL ENGINEERING, STEAM ENGINEERING.

Steamships.

The Evolution of Ocean Steamers. M. B. Cea. Brief description of the new Hamburg-American liner Europa. 1000 w. Cassier's Mag—Dec., 1910. No. 19544 B.

The Largest Ship: the "Europa." Illustrations and brief description of the new vessel of the Hamburg-American Line, a 50,000-ton passenger ship. 800 w. Sci Am—Dec. 17, 1910. No. 19366.

Notes on the Trials and Performances of the S. S. Otaki, Fitted with a Combination of Reciprocating and Turbine Machinery. W. McK. Wisnom. Read before the N.-E. Coast Inst. of Engrs. & Shipbldrs. Supplementing an earlier paper by C. A. Parsons. Gives particulars of the trials, and results. General discussion. 12500 w. Jour Am Soc of Nav Engrs—Nov., 1910. No. 19028 H.

The French Liner France. Illustrated description of the largest and speediest boat of the French merchant marine. 1200 w. Int Marine Engng—Dec., 1910. No. 19207 C.

New Southern Pacific Freight Steamships. Illustrated description of single-screw steel vessels of the ocean-going, hurricane deck type. 2000 w. Int Marine Engng—Dec., 1910. No. 19205 C.

Random Notes on a Lake Freighter. Caspar F. Goodrich. Illustrations and notes on this type of vessel, the appliances for handling the immense cargoes, and matters related. 4800 w. Pro U S Nav Inst—Dec., 1910. No. 19549 E.

Steam Turbines.

See Steam Engines, under MARINE AND NAVAL ENGINEERING.

Steering Gear.

Electric Steering Gear for Ships. K. Trowbridge. Diagrams and brief explanations of various systems. 1000 w. Elec Rev, Lond—Dec. 16, 1910. No. 19579 A.

Submarines.

The Cruise of the Submarine Torpedo Boat Salmon from Quincy, Mass., to Hamilton, Bermuda, and Return, July 5, 17, 1910. D. A. Weaver. A detailed account of an extended deep-sea cruise made under the boat's own power. 2500 w. Jour Am Soc of Nav Engrs—Nov., 1910. No. 19026 H.

Tugs.

A Single Screw Tug. Illustrated description of the tug George V, recently built. 400 w. Engr, Lond—Dec. 16, 1910. No. 19703.

Shallow-Draught Tug for the River Lena. Illustrations and description of a paddle-boat drawing no more than 16 in., and capable of a speed of over 14 knots. 400 w. Engng—Nov. 15, 1910. No. 19192 A.

U. S. Merchant Marine.

Our Constitutional Shipping Policy and the Compact for Its Establishment. William W. Bates. Reviews the early history of the United States in relation to commerce and navigation and criticizes the legislation that has prevented the subsidizing of vessels. 3500 w. Soc of Nav Archts & Marine Engrs, No. 6—Nov. 17, 1910. No. 19465 N.

Water Consumption.

Some Tests on Board Ship to Ascertain the Water Consumption of Engine Room and Deck Auxiliaries. C. F. A. Fyfe. A report of observations made to find how much steam marine auxiliaries use when doing ordinary work in port, and to frame a method of predicting the water consumption at sea for purposes other than the main engines. 6000 w. Inst of Engrs & Shipbldrs in Scotland—March 22, 1910. No. 19773 N.

Yachts.

The Yacht "Mohawk." Illustrated detailed description of a yacht designed by R. E. Barry for cruising single-handed along the Atlantic Coast. 2500 w. Engng—Dec. 16, 1910. No. 19594 A.

MECHANICAL ENGINEERING

AERONAUTICS.

Aeroplane Construction.

Iron and Wood (Eisen und Holz). G. Ewerding. Discusses mathematically the reinforcement of wood with iron for use in aeroplane construction. Ills. Serial. 1st part. 1100 w. Motorwagen—Nov. 10, 1910. No. 19805 D.

See also Alloys, under MATERIALS OF CONSTRUCTION.

Aeroplanes.

The First Marine Aeroplane. Illustrated description of the Fabre hydroaeroplane. 1500 w. Sci Am—Dec. 17, 1910. No. 19364.

Aeroplane Stability.

A Device to Increase the Stability of Aeroplanes (Stabilisationsautomat für Flugmaschinen). Seb. Volz. Describes a device invented by the author. Ills. 2000 w. Motorwagen—Nov. 30, 1910. No. 19807 D.

Airship Flights.

The Willows Dirigible Airship. Illustrations, with an account of a flight from London to France during the night. 1200 w. Sci Am Sup—Dec. 3, 1910. No. 19103.

Altitude.

Determining the Height of Aeroplanes. Commandant Renard. Explains various methods of determining altitude. 2800 w. Sic Am Sup—Dec. 24, 1910. No. 19493.

How Altitude Records Are Made. Illustrates and describes remarkable soarings, and the methods of using the barograph. 1800 w. Sci Am Sup—Dec. 24, 1910. No. 19489.

Balloons.

A Discussion of the War Balloon and Similar Craft, and the Best Methods of Attack by Artillery. Walter E. Prosser. 2200 w. Jour U S Art—Nov.-Dec., 1910. No. 19551 D.

In the Building of Balloons. William B. Ennis. First of a series of articles discussing problems to be solved. Considers aerial statics, and methods for altitude control in the present number. Ills. 2000 w. Automobile—Dec. 22, 1910. Serial. 1st part. No. 19509.

Competitions.

The Milan Aviation Meet (Il Circuito Aereo di Milano). Describes the aerodrome, the competing machines, and the results at the Milan, 1910, meet. Ills. Serial. 1st part. 2000 w. Industria—Nov. 13, 1910. No. 19656 D.

Motors.

Six Aviation Engines. Brief descriptions of the aeronautical motors entered for the Alexander prize competition. 1800 w. Sci Am Sup—Dec. 17, 1910. No. 19367.

AUTOMOBILES.

Agricultural Machinery.

Motor Driven Plow and Cultivator. H. E. Miller. Illustrated description of a Swiss machine said to have proved successful. 1500 w. Sci Am—Dec. 3, 1910. No. 19101.

The Bajac Motor Plow (Le Tracteur-Treuil de M. A. Bajac). Max Ringelmann. Describes the machine and reports tests. Ills. 3200 w. Bul Soc d'Encour—Nov., 1910. No. 19627 G.

Brakes.

Front Wheel Braking. William Paddon. Gives conclusion after 1500 miles road usage. 1600 w. Autocar—Nov. 26, 1910. No. 19174 A.

Front-Wheel Brakes. Reviews the subject, explaining the advantages and disadvantages, the principles and their application. 2500 w. Auto Jour—Nov. 26 1910. Serial. 1st part. No. 19170 A.

Modern Motor Car Brakes—Practical Calculations. F. E. Watts. Discusses the practical calculation of the holding power of brakes. Ills. 2200 w. Horseless Age —Nov. 30, 1910. No. 19140.

Carburetters.

A Constant Vacuum Carburetter. W. Bourne Dale. Sectional drawing, with description by the designer. 2000 w Autocar—Nov. 26, 1910. No. 19173 A.

Commercial Vehicles.

The Sheppee Convertible Steam Motor-Vehicle. Plate, with illustrated detailed description of a vehicle with two interchangeable bodies. 1500 w. Engng—Dec. 2, 1910. No. 19326 A.

The Schneider Motor Truck for Rock Transport (Binard Automobile, Système Schneider, pour le Transport des Pierres de Taille). Brief description. Ills. 2200 w. Génie Civil—Nov. 19, 1910. No. 19642 D.

The Economics of Commercial Vehicles (Zur Rentabilitätsfrage von Motorlastwagenbetrieben). W. Schwerdtfeger. A discussion of first and operating costs, maintenance, depreciation, etc., and of methods of calculation. Ills. Serial. 1st part. 3000 w. Zeitschr d Mit Motorwagen Ver—Nov. 15, 1910. No. 19803 D.

See also Skidding, under Automobiles.

Construction.

The Structural Engineering of Motor Cars. John L. Milligan. Abstract of a paper read before the Manchester Assn. of Engrs. Deals only with pleasure cars, discussing the design, arrangement of machinery, etc. Ills. 3000 w. Mech Engr—Dec. 16, 1910. No. 19588 A.

Daimler.

The 16-18 H. P. Austrian-Daimler Chassis. Illustrated detailed description. 1500 w. Auto Jour—Nov. 26, 1910. No. 19171 A.

Design.

Calculation of an Automobile Rear System. Karl Feilcke. Shows how the dimensions are determined. The present installment covers the axle shafts, driving and differential gears, and the bearings. 2000 w. Horseless Age—Dec. 14, 1910. Serial. 1st part. No. 19403.

Electric.

Storage Batteries for Heavy Traction. Newton Harrison. Explains the requirements, discusses types of storage cells, and other features of the problem. 3000 w. Cent Sta—Dec., 1910. No. 19279.

See also Garages, under Automobiles.

Exhibitions.

The Paris Salon. Illustrates and describes the exhibits, showing Continental designs and tendencies. 3000 w. Autocar—Dec. 10, 1910. No. 19416 A.

The Smithfield Club Show. Illustrates and describes some tractors, and a gas-engine shown, with notes on other exhibits. 2500 w. Engng—Dec. 9, 1910. No. 19445 A.

Fire Engines.

The Practical Use of the Automobile Fire Engine as a Fire-Fighting Apparatus. Charles S. Allen. Read before the Intnat. Assn. of Fire Engrs. Considers problems of construction, the advantages over the horse-drawn apparatus, costs etc. 2000 w. Can Engr—Dec. 15, 1910. No. 19405.

Garages.

The Proper Garaging of Electric Vehicles. C. L. Morgan. Explains a system for obtaining satisfactory results, and the conditions that would make its application advisable. 2500 w. Cent Sta—Dec., 1910. No. 19281.

Germain.

The 15 H. P. Germain. Illustrates and describes the chassis, the unique engine design, overhead valves and camshaft, with silent chain drive. 1200 w. Autocar—Dec. 3, 1910. No. 19309 A.

Ignition.

An Elementary Explanation of Magneto Action. P. M. Heldt. Illustrates and describes the individual parts and their functions. 3500 w. Horseless Age—Nov. 30, 1910. No. 19142.

A Low-Tension Ignition Revival. Illustrated detailed description of the "Hilo" low-tension system. 2500 w. Auto Jour—Dec. 17, 1910. No. 19576 A.

Industry.

American Competition (Amerikanische Gefahr). Adolf Schreiber. Discusses the possibility of the competition of American automobiles with Continental models. Ills. 2800 w. Motorwagen—Nov. 10, 1910. No 19804 D.

Laboratories.

Making the Laboratory Pay. Illustrates and describes features of the laboratory of the E. R. Thomas Co., at Buffalo, and some of the work carried out. 3000 w. Automobile—Dec. 1, 1910. No. 19062.

Locomobile.

Two 1911 Locomobile Models—30 and 48 Horse Power. Illustrated descriptions, calling attention to new features. 2000 w. Horseless Age—Nov. 30, 1910. No. 19143

Materials.

Alloy Steel Tubing for the Automobile Industry. Joseph Schaeffers. Describes a new material of construction for hollow or annular parts which promises a considerable saving in manufacturing cost. 1000 w. Horseless Age—Dec. 7, 1910. No. 19252.

See also Alloy Steels, under Materials of Construction.

Motor Cooling.

Precautions to Be Taken Against Freezing. H. F. Donaldson. Explains mechanical and chemical methods of preventing damage to gas-motor water cooling systems. 1200 w. Com Veh—Dec. 1910. No. 19167 C.

Motor Cycles.

Motor Cycles at Olympia. Illustrations and brief descriptions of cycles exhibited. 1500 w. Auto Jour—Nov. 26, 1910. No. 19172 A.

Motor Pistons.

Pistons for Petrol-Motors. Shows the importance of lightness of pistons in petrol-motors and discusses methods of securing it. Ills. 3000 w. Engng—Dec. 16, 1910. No. 19593 A.

Motor Power.

Simple Power-Measurement on Motor Cars. H. E. Wimperis. Read before the British Assn. On the use of the author's accelerometer. Ills. 1800 w. Auto Jour —Dec. 3, 1910. Serial. 1st part. No. 19311 A.

Motors.

A New Two-Cycle Engine. Illustrates and describes an internal combustion motor without camshafts, valves, or timing gear. 2500 w. Autocar—Nov. 26, 1910. No. 19175 A.

The Knight Motor (Le Moteur Knight). M. de Fréminville. Describes the Knight type of automobile motor and examines its advantages and defects. Ills. 4500 w. Bul Soc d'Encour—Nov., 1910. No. 19630 G.

Motor Troubles.

The "Gas" Knock. Albert L. Clough. Discusses the theory and gives a plausible explanation. 1200 w. Horseless Age—Nov. 30, 1910. No. 19141.

Motor Valves.

Indirect Valve Operation—Pneumatically Operated Valves. Eugene P. Batzell. A discussion of the effect on motor power of operating motor valves by air pressure or vacuum and the change in valve timing with variations in motor speed. Ills. 6000 w. Horseless Age—Dec. 7, 1910. No. 19251.

Napier.

The 65-H. P. 6-Cyl. Napier. Illustrations and brief description of the interesting features of the chassis. 600 w. Auto Jour—Dec. 3, 1910. No. 19310 A.

Omnibuses.

See Paris, under STREET AND ELECTRIC RAILWAYS.

S. C. A. R.

The S. C. A. R. Illustrates and describes details of construction of this runabout car. 1000 w. Auto Jour—Dec. 10, 1910. No. 19415 A.

Skidding.

Preventing Skids and Slips in Commercial Vehicle operation. Illustrates and describes devices being tried. 1500 w. Horseless Age—Dec. 21, 1910. No. 19506.

Tires.

Effect of Speed on Tire Wear. Albert L. Clough. Shows that the destructive effect increases with the speed. 1500 w. Horseless Age. Dec. 21, 1910. No. 19505.

Traffic.

The Development of Road Locomotion in Recent Years. L. A. Legros. Deals particularly with development in Great Britain since 1900. 9000 w. Inst of Mech Engrs—Nov. 18, 1910. 19187 N.

Wheels.

The Lynton Wheel and Tyre. Illustrates and describes types of this wheel and the action. 1500 w. Auto Jour—Dec. 17, 1910. No. 19577 A.

Winter Storage.

Laying Car Up for Winter. Describes how each part should be treated. Ills. 1200 w. Automobile—Dec. 1, 1910. No. 19063.

COMBUSTION MOTORS.

Fuel Leakage.

The Detection of Petroleum Vapor or Gas. John H. Heck. Read before the Inst of Engrs. & Shipbldrs. in Scotland. Describes an improved test for detecting the presence of the vapor or gas. 2200 w. Mech Engr—Dec. 9, 1910. No. 19435 A.

Gas Engines.

The Côte Two-Cycle Engine (Un Moteur à deux Temps de M. Côte). E. Sauvage. Brief illustrated description of a simple type of two-cycle engine. Ills. 1000 w. Bul Soc d'Encour—Nov., 1910. No. 19628 G.

Gas Power Plants.

Gas Power Plant Costs. R. S. Manning. Gives tabulated installation costs of a large gas-driven station in Wisconsin. 600 w. Power—Dec. 6, 1910. No. 19139.

Performance of a Gas Power Plant Using Lignite. A. M. Levin. Describes the performance of a twin single-acting engine running on lignite gas at Turnwater, Wash. 2200 w. Power—Dec. 27, 1910. No. 19574.

Gas Producers.

Notes on a Heavy-Duty Gas Producer. Nisbet Latta. Reports experiments, describing and illustrating apparatus used. 2000 w. Jour Am Soc of Mech Engrs—Dec., 1910. No. 19069 F.

Oil Engines.

600-Horse-Power Diesel Engine. Plate and description of an engine shown in the Dutch Section at the Brussels Exhibition. 1000 w. Engng—Nov. 25, 1910. No. 19191 A.

Power and Fuel-Consumption Tests of a 5 Horse Power, High-Speed, Crude-Oil Diesel Engine (Leistungs- und Verbrauchsversuche an einem schnellaufenden Rohöl-Kleinmotor von 5 PS, gebaut von Diesel & Co.). F. Romberg. Describes the motor and the tests and gives results. Ills. 3800 w. Zeitschr d Ver Deutscher Ing—Nov. 5, 1910. No. 19836 D.

Producer Gas.

Determination of the Calorific Value and of Operating Conditions from Analysis of Industrial Gases. J. M. Morehead. Read before the Am. Gas Inst. Explains the method of gas analysis and what it shows, illustrating apparatus used. 5000 w. Am Gas Lgt Jour—Dec. 12, 1910. Serial. 1st part. No. 19265.

Testing.

See Manograph, under MEASUREMENT.

HEATING AND COOLING.

Air Purification.

Present Status of Ozone With Reference to Air Purification. Ralph D. Small. Address before the Am. Electro-Chem. Soc. Information concerning its production and use. 3500 w. Heat & Vent Mag—Dec., 1910. No. 19554.

Central Station.

See Economics, under ELECTRICAL ENGINEERING, Generating Stations.

Electric Heating.

See Heating, under ELECTRICAL ENGINEERING, Power Applications.

Heating Requirements.

Estimating Heating Requirements. Reginald P. Bolton. Excerpt from a paper read before the Assn. of Edison Ill. Co.'s. Presents a method including the loss by infiltrations. 2500 w. Power—Dec. 27, 1910. No. 19573.

Hot-Water Heating.

Indirect Hot-Water Residence Heating. Plans and description of a combination direct and indirect hot-water system. 900 w. Met Work—Dec. 24, 1910. No. 19557.

Furnace Heating of a New Haven Church. Describes the use of two furnaces with out-door air connection and one for rotary air circulation. Ills. 1800 w. Met Work—Dec. 3, 1910. No. 19119.

Mechanical Furnace Heating of a Church. An interesting system installed in the Presbyterian Church at Laurens, S. C., is described. An electrically driven fan forces air over furnace, and the air is rotated when the building is not occupied. 2000 w. Met Work—Dec. 17, 1910. No. 19379.

Recent Progress in Heating Practice (Mitteilungen aus der neueren Heizungstechnik). Joh. Körting. Describes recent developments in furnace, hot-water, and steam heating practice and apparatus. Ills. 4200 w. Zeitschr d Ver Deutscher Ing—Nov. 19, 1910. No. 19842 D.

Hot-Water Piping.

Corrosion of Hot-Water Piping in Bath-Houses. Ira H. Woolson. Reports results of investigations made. 1800 w. Eng News—Dec. 8, 1910. No. 19238.

Refrigeration.

Pressures in Refrigerating System. F. E. Matthews. Data on temperature and pressures and their relations. 1500 w. Power—Dec. 13, 1910. No. 19289.

Exhaust Steam Ice-Making Plant. Illustrated description of a recent installation of machinery for the ammonia absorption system. 1000 w. Engr, Lond—Dec. 2, 1910. No. 19335 A.

Operating Notes on Refrigeration. F. E. Matthews. Discusses the defrosting of brine and direct-expansion coils, removal of oil and gases, and the effect of incrustation. 2500 w. Power—Dec. 6, 1910. No. 19136.

The Possibility of Applying Centrifugal Compressors to Compression in Refrigeration (Die Möglichkeit der Verwendung von Kreiselgebläsen als Kühlmaschinen-Verdichter). Hans Lorenz. Read at the Second International Congress of the Cold. Ills. 2200 w. Zeitschr f d Gesamte Turbinenwesen—Nov. 30, 1910. No. 19801 D.

The Audiffren Refrigerating System and Small-Scale Refrigeration (I Frigorigeni Audiffren e la Piccola Industria del Freddo). Francesco Mauro. A detailed description of the system and its use in small units. Ills. 2100 w. Monit Tech—Nov. 10, 1910. No. 19652 D.

The Second International Congress of the Cold (IIe Congrès International du Froid, Vienne, 6-12 Octobre 1910). E. Lemaire. Gives a resume of the papers read at the recent Vienna Congress. Serial. 1st part. 3500 w. Génie Civil—Nov. 12, 1910. No. 19641 D.

Ventilation.

The Air We Breathe. William E. Watt. Discusses how vitality comes from the air and what deteriorates it. 2500 w. Dom Engng—Dec. 17, 1910. No. 19396.

Ventilation Troubles in School Buildings. W. A. Evans. Discusses troubles and remedies with special reference to the Chicago schools. 1600 w. Heat & Vent Mag—Dec., 1910. No. 19555.

The Vicious Quatitative Standard in Ventilation. William Henry Lynch. A discussion of the limit of present knowledge of ventilation, arguing that any standardization at the present time would be standardizing ignorance. 4500 w. Dom Engng—Dec. 17, 1910. No. 19397.

HYDRAULIC MACHINERY.

Centrifugal Pumps.

The Design of Centrifugal Pumps. James A. Seager. Illustrates and describes features of interest in recent English designs. 1200 w. Eng & Min Jour—Dec. 17, 1910. No. 19395.

Laboratories.

Our Hydraulic Laboratory. E. W. Schoder. Illustrated description of the Cornell hydraulic laboratory as it is today. 800 w. Cornell Civ Engr—Dec., 1910. No. 19529 C.

Penstocks.

See Pipe Friction, under Hydraulic Machinery.

Pipe Friction.

A Friction Head Diagram for Riveted Steel Pipes or Penstocks. Irving P. Church. Gives a diagram on a logarithmic basis, with explanation. 500 w. Cornell Civ Engr—Dec., 1910. No. 19528 C.

Pipe-Line Surges.

Surges in Pipe Lines. F. G. Baum. Reviews briefly electrical surge phenomena as explained in an earlier paper, and applies the reasoning to pipe lines. Diagrams. 2000 w. Elec Wld—Dec. 8, 1910. No. 19228.

Presses.

See Hydraulic Presses, under MACHINE ELEMENTS AND DESIGN.

Pumping.

The Economical Pumping of Deep Wells. B. C. Sloat Read at the convention of the Eastern Ice Assn. Considers the three types of deep well pumps. Short discussion. 3000 w. Ice & Refrig—Dec., 1910. No. 19258 C.

Pumping Engines.

Report of Dutv Trial on the Six Million Imperial Gallon Pumping Engine at the High Level Pumping Station, Toronto Water Works. Robert W. Angus. Ills. 4500 w. Ap Sci—Dec., 1910. No. 19727 C.

Pumping Plants.

An Electrically Operated Municipal Pumping Station. Alexander J. Lindsay. Illustrated description of an electrically operated pumping station for increasing the supply at Spokane, Wash. 2500 w. Eng Rec—Dec. 10, 1910. No. 19271.

The Development of the Municipal Water-Works of Spokane, Wash., and the Addition of an Electric Pumping Station. Alexander J. Lindsay. Illustrated description of the new electric pumping station, made necessary by the rapid growth of the city. 2500 w. Eng News —Dec. 8, 1910. No. 19237.

Pump Priming.

Means for Priming Pumps. Illustrated description of a device, operating by exhausting air or gas, which is brought into use whenever the pump requires priming. 1200 w. Prac Engr—Dec. 2, 1910. No. 19317 A.

Rams.

Improvements in Hydraulic Rams. Illustrates and describes improvements invented by B. McIntire, of San Salvador. 2500 w. Prac Engr—Dec. 16, 1910. No. 19583 A.

Shears.

See Plate Shears, under MINING AND METALLURGY, IRON AND STEEL.

Turbine Nozzles.

Swinging Nozzles (Schwenkdüsen, ihre Konstruktion und ihre Aufgaben). Herr Kröner. Describes the Henry, Doble, de Wein, Warren and Zodel types. 2400 w. Die Turbine—Nov. 20, 1910. No. 19697 D.

Turbines.

Turbines of Increased Capacity at Niagara Falls, Ont. Illustrated description of an interesting water turbine recently designed and installed by the Canadian Niagara River Co. 700 w. Elec Wld—Dec. 29, 1910. No. 19785.

An Elementary Treatment of Lorenz' Turbine Theory (Elementare Behandlung der Lorenzschen Theorie der Kreiselräder). Felix Langen. Mathematical. Ills. 2500 w. Zeitschr f d Gesamte Turbinenwesen—Nov. 30, 1910. No. 19802 D.

Turbine Screens.

The Flow of Water Through Submerged Screens. Extracts from a thesis by Henry Ryon. An investigation confined to a slat screen with different conditions of pointing and a perforated screen with two different spacings of openings. Ills. 1000 w. Cornell Civ Engr—Dec., 1910. No. 19527 C.

Water Hammer.

A Short Method of Calculating Water Hammer in Pipe Lines of Moderate Length (Sul Calcolo Abbreviato del Colpo d'Ariete nelle Condotte di Moderata Lunghezza). P. Alibrandi. Mathematical demonstration. 2100 w. Ann d Soc d Ing e d Arch Ital—Oct. 1, 1910. No. 19646 F.

Water-Wheel Governors.

Water Wheel Governors. E. R. Frost. Considers conditions affecting regulation and describes types of governors. Ills. 3000 w. Ap Sci—Dec., 1910. No. 19726 C.

MACHINE ELEMENTS AND DESIGN.

Balancing.

The Balancing of Machine Elements (De l'Equilibrage des Organes mécaniques). R. Filloche and Georges Lévy. A detailed study of static and dynamic equilibrium, and of the theory and practice of balancing machine parts. Ills. Serial. 1st part. 3500 w. Tech Mod—Nov., 1910. No. 19620 D.

Ball Bearings.

Ball-Bearing Tests (Ueber Versuche mit Kugellagern). F. Symanzik. Deals with many points in ball-bearings practice based on test results. Ills. Serial. 1st part. 2200 w. Motorwagen—Nov. 20, 1910. No. 19806 D.

Clutches.

See Disc Friction, under MACHINE ELEMENTS AND DESIGN.

Disc Friction.

A Problem in Disk Friction. John S. Myers. Presents a problem in connection with a disk friction clutch which suggests the development of a new theory for arriving at the ideal compromise in machine design. 1800 w. Mach, N Y—Dec., 1910. No. 19110 C.

Drafting Rooms.

See Illumination, under ELECTRICAL ENGINEERING, LIGHTING.

Flywheels.

A Graphical Method for the Design of Flywheels (Notes sur une Méthode Graphique pour le Calcul des Volants). C. Colombi. A mathematical and graphical demonstration of the method. Ills. 2000 w. Rev de Mécan—Nov., 1910. No. 19636 E. + F.

Gears.

Analysis of Velocity Ratios of Epicyclic Gear Trains. A. Lewis Jenkins. Explains various methods of analysis. Ills. 4000 w. Eng News—Dec. 8, 1910. No. 19234.

Gyroscope.

The Gyroscope and Its Useful Possibilities. Elmer A. Sperry. An illustrated explanation of its phenomena is given in the present number, and later articles will review the work of experimenters and the author's development. 3000 w. Ir Age—Dec. 1, 1910. Serial. 1st part. No 19040.

The Theory of the Gyroscope (Zur Theorie des Kreisels). Th. Rosenbaum. Discusses its principles and technical applications. Ills. 7000 w. Schiffbau—Nov. 23, 1910. No. 19687 D.

The Couple which Produces the Tendency to Parallelism in the Axes of the Gyroscope (Note sur le Couple qui Produit, dans le Gyroscope, la "Tendance des Axes au Parallélisme"). H. Janne. A mathematical treatment of the theory of the gyroscope. Ills. Serial. 1st part. 3300 w. Bul Sci d l'Assn d Eleves—Nov., 1910. No. 19626 D.

Hydraulic Presses.

Design of Hydraulic Press Rams. A. Lewis Jenkins. A study of the stresses produced by eccentric loading. 2000 w. Am Mach—Vol. 33. No. 49. No. 19214.

Shafts.

Critical Speeds for Torsional and Longitudinal Vibrations. Arthur Morley. A mathematical determination of the torsional vibrations in shafts. 2500 w. Engng —Dec. 9, 1910. No. 19440 A.

MACHINE WORKS AND FOUNDRIES.

Aluminum Founding.

Foundry Operations on an Aluminum Gear Case Casting. Illustrates and describes work on an automobile gear case. 800 w. Castings—Dec., 1910. No. 19399.

Automatic Machines.

Cutting Keyways in an Automatic Screw Machine. S. N. Bacon. Describes the work. Ills. 1200 w. Mach, N Y—Dec., 1910. No. 19109 C.

See also Lathes, under Machine Works and Foundries.

Brass Founding.

Brass Foundry Costs and Statistics. Charles R. Stevenson. Considers methods by which actual costs can be obtained. 4000 w. Am Brass Found Assn—1910. No. 19010 N.

The Selling of Brass Foundry Refuse. Jesse L. Jones. Discusses methods of disposing of foundry scrap. 2000 w. Am Brass Found Assn—1910. No. 19012 N.

Fluxes as Applied to the Brass Foundry. Erwin S. Sperry. Describes fluxes that time has proved valuable and the manner in which they should be used. 3000 w. Am Brass Found Assn—1910. No. 19013 N.

Gating and Casting Large Bronze Rings. C. Vickers. Illustrates and describes methods used. 1000 w. Foundry —Dec., 1910. No. 19161.

See also Pattern Making, under Machine Works and Foundries; and Lead Assaying, under MINING AND METALLURGY, Lead and Zinc.

Case Hardening.

The Case Hardening and Heat Treatment of Low Carbon Steels. A. C. Sladky and A. F. Schultz. Abstract of a thesis. Reports experiments which show that heat treatment and case-hardening greatly benefit the strength of steel both under static and live loads. Ills. 1000 w. Wis Engr—Dec., 1910. No. 19516 C.

Copper Founding.

See Copper, under Materials of Construction.

Cupolas.

Making a Small Cupola. Walter J. May. Drawings and description. 1000 w. Mech Wld—Dec. 9, 1910. No. 19437 A.

Drilling Machines.

A New Radial Drilling Machine. Illustrates and describes a new design by Loudon Brothers, in which all adjustments of the tool can be operated from the saddle. 1200 w. Engr, Lond—Dec. 2, 1910. No. 19336 A.

Forging.

Tools and Dies for Drop Forging. E. F. Lake. Illustrates and describes the tools and dies and the forgings made, showing the variety of work. 1800 w. Am Mach—Vol. 33. No. 50. No. 19348.

Foundries.

The New Hartung Foundry at Berlin-Lichtenberg (Neue Giesserei-Anlage der Hartung Akt.-Ges. in Berlin-Lichtenberg). Th. Ehrhardt. Describes an installation embodying the most modern practice in foundry design. Ills. 3800 w. Stahl u Eisen—Nov. 9, 1910. No. 19666 D.

Foundry Coke.

The Coke Industry of the United States as Related to the Foundry. Richard Moldenke. Reviews the coke industry, features of practice in the use of coke in the foundry, the probable processes of a cupola heat, and the reasons for modifying practice so that a particular coke can be used to advantage. 11000 w. U S Bureau of Mines—Bul. 3. No. 19525 N.

Foundry Design.

Typical Modern Foundry Layouts. H. Cole Estep. Plans and description of the arrangement and equipment of gray iron foundries of varying capacities. 800 w. Minn Engr—Nov., 1910. No. 19759 C.

Foundry Furnaces.

Electric Power Required to Melt Metals. Joseph W. Richards. Considers the proper basis for information in this field. 1500 w. Am Brass Found Assn—1910. No. 19015 N.

The New Rockwell Tilting Furnace. Illustrated description of a furnace pouring directly into molds without crucible or ladle. 900 w. Ir Age—Dec. 29, 1910. No. 19776.

Foundry Lighting.

Lighting a large Iron Foundry. G. H. Stickney. Considers illumination for molding and pouring, reporting tests made. 2000 w. Am Mach—Vol. 33. No. 48. No. 19044.

Foundry Materials.

See Ferro-Alloys, under MINING AND METALLURGY, IRON AND STEEL.

Foundry Practice.

Use of Vanadium in Steel Castings. Illustrated description of methods of molding and casting vanadium steel employed by the Union Steel Casting Co., Pittsburg. 1400 w. Foundry—Dec., 1910. No. 19158.

The Production of Cast Steel in the Converter (Konverter-Stahlguss). J. Holicky. A brief description of the Tropenas process. Ills. Serial. 1st part. 1500 w. Giesserei-Zeit—Nov. 15, 1910. No. 19678 D.

Furnaces.

Producer and Water Gas for Furnaces. L. B. Lent. Information on which to base a calculation as to whether it will be profitable to install and use gas made from solid fuel. 3300 w. Am Mach—Vol. 33. No. 49. No. 19213.

Gear Cutting.

Involute Cut-Gearing. S. H. Rowley. Discusses present results and practices adopted for its production. Ills. 2500 w. Mech Engr—Dec. 2, 1910. Serial. 1st part. No. 19320 A.

Grinding.

The Field for Grinding. C. H. Norton. An illustrated account of results attained by the use of the modern grinding machine and grinding wheel. 2500 w. Jour Am Soc of Mech Engrs—Dec., 1910. No. 19072 F.

Modern Grinding Methods. B. M. W. Hanson. Illustrated discussion of recent improvements to grinding machines and devices used to control the work. 2000 w. Jour Am Soc of Mech Engrs—Dec., 1910. No. 19074 F.

Precision Grinding. W. A. Viall. Considers the possibilities of grinding and things that must receive attention to make the work a mechanical and financial success. 2000 w. Jour Am Soc of Mech Engrs—Dec., 1910. No. 19073 F.

Lathes.

Manufacturing on the Engine Lathe. H. M. Wood. Describes a development in machine design which enables repetition work to be produced rapidly upon an engine lathe. Ills. 1200 w. Am Mach—Vol. 33. No. 48. No. 19045.

Slotting-Machines and Capstan Lathes. Illustrated detailed description of machine tools made at Lupton, Eng. 2000 w. Engng—Dec. 9, 1910. No. 19441 A.

English 24-Inch Lathe. W. H. Haggas. Illustrated description of an interesting modern design. 900 w. Mach, N Y—Dec., 1910. No. 19105 C.

Machine Tools.

Clamping and Locking Devices Applied to Machine Tools. Joseph G. Horner. Illustrates and describes typical devices, showing American, English, and German practice. 2500 w. Mach (Ry Ed)—Dec., 1910. No. 19294 C.

See also Safety Devices, under MISCELLANY.

Metal Finishes.

The Bradley Rust-Proof Black Finish for Iron and Steel and the Method of Producing It. An illustrated description of this process. 1000 w. Brass Wld—Dec., 1910. No. 19497.

Milling Machines.

A New Plain Milling Machine. Illustrated detailed description of the Brown & Sharpe No. 13 B constant speed type. 1000 w. Ir Age—Dec. 29, 1910. No. 19774.

Molding.

Molding Branch Pipes in Dry Sand. Howard C. Deysher. Illustrated description of the work. 1000 w. Foundry—Dec., 1910. No. 19159.

Molding Sand.

The Preparation of Molding Sand (Ein Streifzug durch das Gebiet der Formsandaufbereitung). E. Bauer. A general discussion of the subject. Serial. 1st part. 2400 w. Giesserei-Zeit—Nov. 1, 1910. No. 19677 D.

Magnetic Separation in the Foundry (Elektromagnetische Eisenseparatoren im Giessereibetriebe). Erich Oppen. Describes a number of apparatus for removing particles of iron from molding sand. Ills. 2600 w. Stahl u Eisen—Nov. 9, 1910. No. 19667 D.

Molding Machines.

Molding Machines, Stripping-plates, and arranging Patterns. R. H. Palmer. Discusses ways of using molding-machines and the apparatus necessary for their proper handling. 2500 w. Castings—Dec., 1910. No. 19401.

Pattern Making.

Making Patterns for Brass Valves. Frank B. Lucas. Describes method for castings made in quantities. Ills. 2000 w. Foundry—Dec., 1910. No. 19163.

See also Woodworking Machines, under MACHINE WORKS AND FOUNDRIES.

Patterns.

Pattern and Mold of a Valve for Pumping Engine. John Williams. Illustrated description of foundry work on a valve. 1200 w. Castings—Dec., 1910. No. 19400.

Making Patterns from Oiled Sand. Illustrates and describes a new method and new material for pattern making, used in making injectors. 1700 w. Am Mach—Vol. 33. No. 49. No. 19210.

The Utility of the Skeleton Pattern. J. R. Moorhouse. Methods of making skeleton patterns are explained and their economy and scope. Ills. 2200 w. Foundry—Dec., 1910. No. 19160.

Screw Cutting.

Cutting Fractional Screw Threads. Martin H. Ball. Gives tables, with explanation of their use. 800 w. Mach, N Y—Dec., 1910. No. 19108 C.

Sheet-Metal Working.

Manufacturing an Accurate Pawl. A. C. Lindholm. Explains troubles encountered, which were overcome by making the pawls on the punch press from sheet metal. Ills. 1000 w. Am Mach—Vol. 33. No. 40. No. 19347.

Shop Appliances.

Tools at the Springfield Armory. S. B. Redfield. Illustrates and describes interesting special tools and dies. 2500 w. Am Mach—Vol. 33. No. 48. No. 19043.

Shop Design.

Modern Machine Shops and Industrial Plants. Charles Day. A descriptive analysis of various typical plants. Ills. 3000 w. Engineering Magazine—Jan., 1911. No. 19743 B.

Efficient Departmental Arrangement. Oscar E. Perrigo. Discusses the planning of a manufacturing plant to secure maximum results with highest economy. 3300 w. Ir Trd Rev—Dec. 29, 1910. No. 19778.

Rearrangement of Machine Tools; Union Pacific Locomotive Shop, Omaha, Neb. Gives plate, and describes the new shop layout. 700 w. Ry Age Gaz—Dec. 2, 1910. No. 19118.

Shop Practice.

The Hammer and Chisel. James Stormonth. Suggestions for the proper use of these tools. 2000 w. Mech Wld—Dec. 2, 1910. No. 19321 A.

Some Hints on Lining-Out. Fred Horner. On the importance of this work, with suggestions. 1500 w. Mech Wld—Dec. 9, 1910. Serial. 1st part. No. 19436 A.

Shop Kinks. F. E. Lister. Illustrates and describes interesting methods used in the Lehigh Valley shops at Sayre, Pa. 6000 w. Ry Age Gaz—Dec. 2, 1910. No. 19116.

Shops.

The Telephone Works of the Western Electric Co., Ltd., Woolwich. Illustrated description of the apparatus factory, with particulars of the plant and methods of organization. 2500 w. Elec Rev, Lond—Dec. 16, 1910. No. 19580 A.

The New Shops of the Bechem & Keetman Works of the Deutscher Maschinenfabrik A. G., Duisburg, Germany (Die Neuanlagen der Deutschen Maschinenfabrik A. G., Werk Bechem & Keetman in Duisburg). Describes an extensive modern plant for the manufacture of heavy machinery. Ills. Serial. 1st part. 3600 w. Stahl u Eisen—Nov. 30, 1910. No. 19676 D.

Shop Ventilation.

The Determination of Impurities in Factory Air (L'Aria degli Ambienti Industriali e le Misurazioni degli Inquinamenti). Discusses particularly the researches of Henriet. 2000 w. Monit Tech—Oct. 30, 1910. No. 19650 D.

Slotters.

See Lathes, under MACHINE WORKS AND FOUNDRIES.

Tool Rooms.

A Large Tool-Room and Its System. Franklin D. Jones. Illustrates and describes methods employed in the toolmaking department of the Taft-Peirce Mfg. Co. 2500 w. Mach, N Y—Dec., 1910. No. 19107 C.

Welding.

Electrically Welded Vehicle Wheels. Illustrates and describes methods of manufacturing light, strong, steel wheels for small vehicles, which are put together in electric welding machines. 1500 w. Am Mach—Vol. 33. No. 48. No. 19042.

The Development of Autogenous Welding and of Autogenous-Welding Apparatus (Zur Entwicklung der autogenen Metallbearbeitung und der hierzu notwendigen Betriebsmittel). August Bauschlicher. A review of the recent developments in this field. Ills. 5500 w. Zeitschr f Werkzeug—Nov. 25, 1910. No. 19817 D.

Autogenous Welding and Metal Cutting by Means of Oxygen (La Soudure autogène et le Coupage a l'Oxygène). A review of recent literature. 2500 w. Rev d'Econ Indus—Nov. 20, 1910. No. 19625 D.

Woodworking Machines.

A Wood Milling Machine. A. N. Spencer. Illustrated description of the Wadkin mechanical woodworker, made in England, and its use in pattern making. 2500 w. Am Found Assn—1910. No. 19007 N.

MATERIALS OF CONSTRUCTION.

Alloys.

Light-Weight Alloys for Aeroplanes. Information concerning these alloys. 2000 w. Foundry—Dec., 1910. No. 19162.

Some Alloys for Permanent Magnets. C. F. Burgess and James Aston. A record of tests in carbon-free alloys. 3000 w. Met & Chem Engng—Dec., 1910. No. 19302 C.

Alloys of Nickel and Cobalt with Chromium. Elwood Haynes. Read before the Am. Chem. Soc. Describes experimental work and the results. 3000 w. Jour of Worcester Poly Inst—Nov., 1910. No. 19018 C.

Alloy Steels.

The Selection and Treatment of Alloy Steels for Automobiles. Henry Souther. Treats of various kinds of alloy steels and their applications in the automobile industry. 5000 w. Jour Fr Inst—Dec., 1910. No. 19719 D.

Manganese Steel. F. E. Johnson. Information concerning this material and its characteristics, its manufacture and uses. 3000 w. Jour Assn of Engng Socs—Nov., 1910. No. 19723 C.

Manganese Steel. J. F. Springer. An illustrated article on the manufacture and applications of a special alloy steel. 8000 w. Cassier's Mag—Dec., 1910. No. 19538 B.

See also Materials, under AUTOMOBILES; and Foundry Practice, under MACHINE WORKS AND FOUNDRIES.

Bearing Metals.

Bearing Metals, or Anti-Friction Alloys. A Napier. From *Foundry Trade Jour.* Notes on the qualities and composition of bronzes for bearings, white anti-friction alloys, etc. 2000 w. Mech Wld—Dec. 16, 1910. No. 19590 A.

An Investigation of Bearing Metals. H. B. McDermid. Describes investigations to determine whether the cost of making bearings could be reduced without dangerously lowering the factor of safety. 3000 w. Am Mach—Vol. 33. No. 49. No. 19212.

Cast Iron.

The Physics of Cast Iron. H. M. Lane. Considers the physical changes that take place as the metal cools and the effect these have on the output of the plant. Ills. 6000 w. Am Found Assn—1910. No 19009 N.

Chemical Standards for Iron Castings. Report by John Jermain Porter, Chairman of Committee. A voluminous report on the constitution, properties, and chemical standards, with a directory of brands of pig iron, and bibliography. 33500 w. Am Found Assn—1910. No. 19008 N.

Copper.

Casting Copper of a High Electrical Conductivity. Dr. E. Weintraub. Considers causes of the cavities in copper castings, and the use of boron to solve the problem. 1000 w. Castings—Dec., 1910. No. 19398.

Economics.

Material Economics. T. D. Lynch. Discusses the importance of research work, design, manufacture, and cost in the appropriate application of materials. Also discussion. 8500 w. Pro Engrs' Soc of W Penn—Nov., 1910. No. 19546 D.

Fatigue.

The Fatigue of Metals and the New Methods of Testing (La Fatigue des Métaux et les Nouvelles Méthodes d'Essais). Ch. Fremont. Discusses particularly in this series the testing of steel for rivets and of welds. Ills. Serial. 1st part. 2500 w. Génie Civil—Nov. 19, 1910. No. 19643 D.

Heat Treatment.

The Heat Treatment of Metallic Materials (Quelques Observations sur les Traitements thermiques des Produits métallurgiques). Léon Guillet. The first part discusses tempering. Serial. 1st part. 4500 w. Tech Mod—Nov., 1910. No. 19616 D.

Metallography.

Quantitative Analysis of Carbon Steels by Means of the Microscope (Analyse Quantitative Micrographique des Aciers au Carbone). F. Robin. An explanation of the method. Ills. 2500 w. Rev de Mécan—Nov., 1910. No. 19631 E + F.

Steel.

Electro Steel—A New Metallurgical Product. Joseph Schaeffers. Information concerning steel manufactured in electric furnaces, its comparative freedom from injurious impurities. Ills. 1200 w. Horseless Age—Dec. 14, 1910. No. 19402.

See also Case Hardening, under MACHINE WORKS AND FOUNDRIES.

Tin Plate.

Corrosion of Metallic Food Containers. Edward Gudeman. Read before the Am. Chem. Soc. Reports experiments made to find a metal that would resist the corroding action of food juices. 2000 w. Met & Chem Engng—Dec., 1910. No. 19304 C.

MEASUREMENT.

Calorimetry.

Experiments on a Bomb Calorimeter. E. A. Allcut. Reports experiments undertaken to find out the exact effect on the combustion (if any) of the pressure of oxygen in the calorimeter. Ills. 2000 w. Engng—Dec. 2, 1910. No. 19324 A.

Hardness.

The Physical Interpretation of Hardness as Measured by the Shore Scleroscope. Richard Henry Greaves. Describes tests made with this instrument, giving results. 2500 w. Inst of Civ Engrs—No. 3879. No. 19471 N.

Manograph.

The Ravigneaux Manograph. W. F. Bradley. Illustrated description of a manograph designed for testing internal combustion motors. 500 w. Mach, N Y—Dec., 1910. No. 19106 C.

Pressure Gauges.

The Measurement of the Pressure and Speed of Gases and Steam (Bestimmung des Druckes und der Geschwindigkeit von Gasen und Dämpfen). E. Stach. Describes a number of methods and apparatus for pressure and speed measurement. Ills. Serial. 1st part. 3200 w. Glückauf—Nov. 19, 1910. No. 19682 D.

Testing Methods.

See Fatigue, under MATERIALS OF CONSTRUCTION.

POWER AND TRANSMISSION.

Air Compressors.

The "Sentinel" Air-Compressors. Explanation of the aim, and detailed illustrated description of the machine. 1700 w. Col Guard—Nov. 25, 1910. No. 19189 A.

Hydraulic Compressors (Hydraulische Kompressoren). P. Bernstein. Discusses their theory, describes installations, and compares with other methods of air compression. Ills. 7200 w. Zeitschr d Ver Deutscher Ing—Nov. 5, 1910. No. 19837 D.

The Measurement of the Volume of Air Delivered by Reciprocating Compressors (Beitrag zur Frage der Luftmengenmessung bei Kolbenkompressoren). Rudolf Lorenz. Reports the results of a number of tests. Ills. 3000 w. Glückauf—Nov. 26, 1910. No. 19684 D.

Belt Driving.

A New Theory of Belt Driving. Selby Haar. A report of modern experimental work and the conclusions reached. 4000 w. Jour Am Soc of Mech Engrs—Dec., 1910. No. 19066 F.

Compressed Air.

Compressed Air Transmission Tables Frank Richards. Gives tables showing the loss in head for different initial pressures and rates of flow with various lengths and diameters of pipe. 900 w. Power—Dec. 6, 1910. No. 19134.

Electric Driving.

An Electrically Driven Chemical Manure Works. Illustrates and describes the various processes and the conditions under which the electrical machinery is operated in the works at Victoria Docks, London. 1500 w. Engr, Lond—Dec. 2 1910. No. 19330 A.

See also Steel Works, under MINING AND METALLURGY, Iron and Steel.

Lubricants.

Some Physical and Chemical Properties of Lubricants. F. A. McCarty. Read before the Victorian Inst. of Elec. Engrs Outlines the sources and manufacture of oils, showing where the impurities come from and describes apparatus used and results of tests made with oils and greases 5000 w. Aust Min Stand—Nov. 2, 1910. Serial. 2 parts. No. 19340 each B.

Mechanical Plants.

The Whitehall Building's Mechanical Plant. Charles H. Hughes. Illustrates and describes interesting details of the equipment of New York's recently completed 32-story high building. 1700 w. Ir Age—Dec. 29, 1910. No. 19775.

A High School Engineering Equipment, With Unique Features. Plans and description of the new East Side Commercial and Manual Training High School in Newark, N. J. 2500 w. Heat & Vent Mag—Dec., 1910. No. 19556.

Power Plants.

The Generation of Power. D. S. Jacobus. Address on the growth in consumption of power, and improvements in its development, with a discussion of the type of boiler best suited for power plant work, and related subjects. 4500 w. Jour Fr Inst—Dec., 1910. No. 19717 D.

Modern Manufacturing Power Plant. Warren O. Rogers. Illustrated description of the mechanical equipment and arrangement of an up-to-date turbine plant. 3000 w. Power—Dec. 13, 1910. No. 19286.

Power Plant Practice. John A. Shaw. Describes the organization and methods found necessary by the Canadian Pacific Ry system to obtain efficient plants. Ills. 6500 w. Can Soc of Civ Engrs—Nov. 10, 1910. No. 19017 N.

Rope Driving.

Rope Driving. Thomas Hart. Presents some of the advantages and applications calling attention to important principles to be kept in mind. Ills. 1500 w. Ir & Coal Trds Rev—Dec. 2, 1910. No. 19452 A.

Turbo-Compressors.

See Refrigeration, under Heating and Cooling.

Wind Power.

Water Storage *versus* Storage Batteries. A. W. Barham. Suggests that the water storage scheme proposed by Prof. R. A. Fessenden for utilizing wind power would afford a method of dealing with peak loads on generating stations. 1500 w. Elect'n, Lond—Dec. 2, 1910. No. 19314 A.

STEAM ENGINEERING.

Air Pumps.

Centrifugal Ejector Air Pump and Condenser. Illustrated detailed description of an air-pump which works on a new principle, recently designed by E. S. G. Rees, a development of the Rees returbo centrifugal pump. 1500 w. Engr, Lond—Dec. 2, 1910. No. 19332 A.

Air Pumps and Condensers as Used in Naval Machinery. F. H. Bailey. Lecture before the School of Marine Engng, U. S. Naval Acad. Discusses the importance of keeping air out of the condenser, and the methods of removing steam, air, and fresh water from turbine condensers. 5500 w. Jour Am Soc of Nav Engrs—Nov., 1910. No. 19025 H.

Boiler Design.

Steam-Boiler Design. Charles Erith. Compares Dr. Nicolson's experimental boiler with ordinary Lancashire boilers, and discusses the effect of firing; the steaming quality depending on the furnace area and quality of fuel, all boilers giving the same efficiency. 3000 w. Engng—Dec. 2, 1910. No. 19327 A.

Boiler Efficiency.

Combustion and Boiler Efficiency. Edw A. Uehling. Discusses the importance of carbon dioxide as an index to combustion and, in connection with flue-gas temperature, to boiler efficiency. Tables. 8500 w Jour Am Soc of Mech Engrs—Dec., 1910. No. 19068 F.

Boiler Explosions.

The Distington Multiple Boiler Explosion. The report of Edward G. Hiller, issued by the Nat. Boiler & Gen. Ins. Co., Ltd. Gives interesting details of the disaster. Ills. 2000 w. Mech Engr—Dec. 9, 1910. Serial. 1st part. No. 19434 A.

Boiler Furnaces.

Some Important Furnace Alterations. A. D. Blake. Explains how the capacity was increased 33 1/3% by substituting a suspended arch in place of the usual form of sprung arch. Ills. 700 w. Power—Dec. 6, 1910. No. 19133.

Boiler Insurance.

Steam Boiler Insurance. Address before the Insurance Institute of Hartford, Conn., by Charles S. Blake. Considers boiler underwriting, inspection and adjustment. 5500 w. Locomotive—Oct. 25 1910. No. 19498.

Boiler Management.

The Clinkering of Coal: Results of Tests for Effect of Various Constituents in the Ash. Lionel S. Marks. Reports investigations made to discover how to diminish or modify clinker, explaining its production. Also editorial. 9500 w. Eng News—Dec. 8, 1910. No. 19235.

Boilers.

Wooden Boilers. Extract from New Haven *Evening Register.* A republished account of an accident in 1817 to a vessel using wooden boilers, with illustration and description of a wooden boiler. 1000 w. Locomotive—Oct. 25, 1910. No. 19499.

Boiler Settings.

Reinforced-Concrete Boiler Settings. W. H. Weston. Gives general working specifications for the construction. 1800 w. Engineering Magazine—Jan., 1911. No. 19745 B.

Boiler Tests.

See Steam Boilers, under MARINE AND NAVAL ENGINEERING.

Boiler Theory.

Combustion. E. N. Percy. An explanation of energy and heat, the products of combustion, sources of loss and related subjects. 3500 w. Boiler Maker—Dec., 1910. No. 19297.

Condensers.

See Air Pumps, under STEAM ENGINEERING.

Engine Cut-off.

See Plant Design, under STEAM ENGINEERING.

Engine Economy.

Water Rates for Simple Engines. Wallace S. Fowler. Gives curve and method of calculating water consumption for simple engines, both condensing and non-condensing, at different loads. 700 w. Power—Dec. 13, 1910. No. 19287.

Engine Governing.

The Governing of Prime Movers. L. Lumb. Abstract of a paper read before the Bradford Engng. Soc. Describes the method of increasing speed variation; the causes of irregularities are discussed. 1600 w. Mech Wld—Dec. 9, 1910. Serial. 1st part. No. 19439 A.

Engine Governors.

An Improvement in Isochronal Engine Governors (Un Nuovo Apparato per la Regolazione Isocrona dei Motori). Lamberto Caioli. Describes a device invented by the author for application to centrifugal governors. Ills. 1400 w. Ann d Soc d Ing e d Arch Ital—Oct. 15, 1910. No. 19649 F.

Engine Repairs.

Repair of a Large Engine Bed. F. W. Brady and C. J. Mason. The guide barrel was split off from the frame. Illustrated description of method of repairing. 900 w. Power—Dec. 27, 1910. No. 19572.

Engines.

Engines with a Minimum of Clearance. Illustrates and describes a Walschaert engine which has a clearance of ½ of one per cent. 500 w. Power—Dec. 13, 1910. No. 19290.

A New Twin-Tandem Rolling Mill Engine. Abstracted from *Stahl und Eisen.* Illustrated description of a twin-tandem reversing rolling-mill engine with built-in pinion housing. 1000 w. Ir & Coal Trds Rev—Nov. 25, 1910. No. 19199 A.

A New Experimental Steam Engine at the Glasgow and West of Scotland Technical College. A. L. Mellanby, Illustrated description of the engine, and results of trials. 3500 w. Inst of Engrs & Shipbldrs in Scotland—April 26, 1910. No. 19772 N.

The Uni-Directional Flow Steam Engine (Die Gleichstrom-Dampfmaschine). J. Stumpf. A detailed description and discussion of the author's system. Ills. Serial. 1st part. 4900 w. Zeitschr d Ver Deutscher Ing—Nov. 5, 1910. No. 19835 D.

Fuels.

A Method of Increasing the Calorific Power of Washington Lignites. H. K. Benson. Abstract of a paper submitted for the Karl prize in Ind Chem. A report of experiments and results. 1000 w. Met & Chem Engng—Dec., 1910. No. 19305 C.

North Dakota Lignite as a Fuel for Power-Plant Boilers. D. T. Randall and Henry Kreisinger. A report of tests, describing the fuel, apparatus and methods giving data results of the tests. Ills. 12500 w. U S Bureau of Mines—Bul. 2. No. 19165 N.

See also Briquetting, under MINING AND METALLURGY, COAL AND COKE.

Fuel Testing.

Engineer's Problem in Selecting Coal. George H. Bayne. Gives a standardization test of three kinds of coal and sample computations upon which the selection is based. 2500 w. Power—Dec. 6, 1910. No. 19137.

Heat Accumulators.

Heat Accumulators for Utilizing Exhaust Steam. E. Stach. From a paper read before the Düsseldorf Cong. Illustrates and describes several types. 700 w.

Ir & Coal Trds Rev—Nov. 25, 1910. No. 19198 A.

Heat Transmission.

A Study in Heat Transmission. J. K. Clement and C. M. Garland. From Bul No. 40, Univ. of Ills. An investigation of the effect of velocity of flow on the rate of transmission of heat through metal walls. 3500 w. Ir Trd Rev—Dec. 1, 1910. No. 19060.

Plant Design.

Factors Affecting Plant Costs. H. J. Macintire. Considers factors which determine the location of steam plant and selection of its equipment. Also a graphical method of determining the economical cut-off. 1200 w. Power—Dec. 6, 1910. No. 19135.

Oil Separators.

Tests of Oil Separators (Versuche mit Dampfentölern). Reports an elaborate series of tests recently carried out in Germany. Ills. Serial. 1st part. 5400 w. Zeitschr d Ver Deutscher Ing—Nov. 19, 1910. No. 19841 D.

Steam Pipes.

Something about Pipe Covering. Trans from *Der Chem.-Tech. Fab.* Shows how the covering can be accomplished with small outlay. 1500 w. Sci Am—Dec. 3, 1910. No. 19099.

Steam Properties.

Problem in Expansion of Steam. John French. Presents an approximate solution for determining the pressure at the end of the stroke. 500 w. Power—Dec. 10, 1910 No. 19288.

Superheating.

Notes on the Value of Napier's Coefficient with Superheated Steam. Isaac Harter, Jr. Gives observations made in a series of tests. 1000 w. Jour Am Soc of Mech Engrs—Dec., 1910. No. 19067 F.

Turbine Design.

The Steam Turbine in Germany. F. E. Junge and E. Heinrich. A comparison of the Rateau and Curtis principles of construction. Ills. 2000 w. Power—Dec. 20, 1910. No. 19458.

Turbine Governors.

The Conditions of Absolute Regularity in Governors (Wann wird ein Regulator schwankungslos arbeiten?). Albert Hoeppener. A mathematical and kinematic study of turbine governors. Ills. Serial. 1st part. 3200 w. Die Turbine—Nov. 20, 1910. No. 19698 D.

Turbine Operation.

The Running and Upkeep of Parsons Steam Turbines. B. Thomas. Illustrates and examines the parts of a turbine, considering their uses; the method of starting, lubricating, etc. 2500 w. Mech Wld —Dec. 9, 1910. Serial. 1st part. No. 19438 A.

Turbine Plants.

The Mixed-Pressure Turbo-Generator Plant at Shaft III of the Constantin der Grosse Mine (Die Zweidruck-Turbogeneratoranlage der Zeche Constantin der Grosse, Schacht III). E. Illgen. Describes a recent plant for the utilization of exhaust steam in the Bochum district, Germany. Ills. 6000 w. Glückauf—Nov. 12, 1910. No. 19681 D.

Turbines.

Low Presure Steam Turbines. F. E. McKee. Discusses the subject in a general way as influencing the modernizing of engine plants, and the design of new plants. Also discussion. 3500 w. Pro Engrs Soc of W Penn—Nov., 1910. No. 19545 D.

The Forerunners and Successors of the Curtis Steam Turbine (Die Dampfturbine von Curtis, ihre Vorläufer und Nachfolger). A review of turbine development based on patent literature. Ills. 4000 w. Die Turbine—Nov. 5, 1910. No. 19695 D.

Turbine Testing.

Testing Steam Turbines and Steam Turbo-Generators. E. D. Dickinson and L. T. Robinson. Outlines the precautions that must be taken in efficiency tests that the results may not be misleading, and also considers the degrees of accuracy of different methods. 3300 w. Pro Am Inst of Elec Engrs—Dec., 1910. No. 19709 F.

Turbine Tests.

Test of a 9000-KW. Turbo-Generator Set. F. H. Varney. Describes the operation of a plant in California, giving data of tests. 1000 w. Jour Am Soc of Mech Engrs—Dec., 1910. No. 19071 F.

Test of a 10000-KW. Steam Turbine with a Brief Description of Features of Construction. Sam. L. Naphtaly. Refers to the design and operation of a complete expansion turbine installed in a San Francisco station, reporting results of tests. Ills. 3000 w. Jour Am Soc of Mech Engrs—Dec., 1910. No. 19070 F.

Test of a 15000-Kilowatt Steam Engine Turbine Unit. Reports remarkable efficiencies obtained by coupling a low-pressure turbine to a reciprocating-engine installation. Ills. 2500 w. Elec Rev & W Elect'n—Dec. 10, 1910. No. 19268.

Tests of a 200-Kilowatt A. E. G. Turbine (Untersuchung einer 200 KW-A.-E.-G.-Turbine). Report of an elaborate test carried out at the Technical High School Charlottenburg. Ills. Serial. 1st part. 2300 w. Zeitschr f d Gesamte Turbinenwesen—Nov. 10, 1910. No. 19699 D.

TRANSPORTING AND CONVEYING.

Aerial Tramways.

Recent Electrical Transporting and Hoisting Machinery (Neuere Transport- und Hebezeuge mit elektrischem Antrieb). Hubert Hermanns. Describes particularly aerial tramway installations. Ills. Serial. 1st part. 3500 w. Elek Kraft u Bahnen—Nov. 4, 1910. No. 19819 D.

Cableways.

Aerial Ropeway at Steetley Quarries. Illustrations and description of an unusual lay-out, used for distributing the limestone and dealing with the waste. 800 w. Engng—Nov. 25, 1910. No. 19194 A.

A Rock-Transporting Cableway for the Harbor Works of Rangoon, Burmah. Illustrated description of the cableway at Kalagouk island, for supplying rock for a rubble training wall. 1500 w. Eng News —Dec. 8, 1910. No. 19233.

The Wetterhorn Lift at Grindelwald, Switzerland. Dr. E. L. Corthell. Illustrated description of a new method of passenger transportation, and a new method of construction by which considerable elevations may be overcome at comparatively small expense. 2500 w. Eng Rec—Dec. 3, 1910. No. 19085.

Cableways for Passenger Transport (Seilschwebebahnen für Personenbeförderung). M. Buhl. Describes a number of cableway installations for this purpose. Ills. Serial. 1st part. 1800 w. Deutsche Bau—Nov. 5, 1910. No. 19689 B.

Boiler Settings.

Mechanical Handling of Coal at the Storage Depots of the Orleans Railway (Note sur l'Organisation de la Manutention mécanique des Combustibles dans les principaux Dépots du Réseau d'Orléans). M. Lacoin. Brief description of the installations. Ills. 1700 w. Rev Gen d Chemins de Fer—Nov., 1910. No. 19615 G.

Coal and Ash Handling Devices at the Reisholz Station of the Rhine-Westfalian Electrical Company (Die Transportanlage der Zentrale Reisholz des Rheinisch-Westfälischen Elektrizitätswerkes A.-G.). A. Pietrkowski. Describes an elaborate installation. Ills. 2300 w. Elek Kraft u Bahnen—Nov. 4, 1910. No. 19820 D.

See also Colliers, under MARINE AND NAVAL ENGINEERING.

Cranes.

Rapid Luffing-Cranes at Morocco Wharf, Wapping. Illustrated description of the Mitchell-Williams system. 1700 w Engng—Dec. 2, 1910. No. 19328 A.

Elevators.

Operating Conditions of Passenger Elevators. Reginald P. Bolton. Discusses the principles that affect and limit the service. 3000 w. Jour Am Soc of Mech Engrs—Dec., 1910. No. 19065 F.

Worm Gearing Employed for Freight Elevators. A. P. Eltoft. Suggests improvements and considers the three factors which may determine the minimum size of worm that can be used. 1500 w. Mach, N Y—Dec., 1910. No. 19111 C.

Freight Handling.

See Steamships, under MARINE AND NAVAL ENGINEERING.

Pulley Blocks.

Chain Pulley Blocks. R. A. Baxter. Considers chain blocks and their upkeep. 1500 w. Mech Wld—Dec. 16, 1910. No. 19591 A.

MISCELLANY.

Copying Machines.

Copying Machines at the Brussels Exhibition. Illustrates and describes types shown by Mr. Curd Nube. 1600 w. Engng —Dec. 16, 1910. No. 19595 A.

Safes.

Recent Advances in the Construction of Fire and Burglar-Proof Safes. E. E. Watson. An account of progress during the past century in lock-making and safe-building. 6000 w. Jour Fr Inst—Dec., 1910. No. 19718 D.

Safety Devices.

Guarding Gears on Machine Tools. Brief illustrated description of gear covers that prevent all possibility of injury to workmen. 600 w. Am Mach—Vol. 33. No. 50. No. 19345.

Mechanical Appliances for Health and Safety in the Weaving Industry. H. M. Crawford. Illustrates and describes devices for the prevention of injuries to employees. 2500 w. Cassier's Mag—Dec., 1910. No. 19539 B.

Shoe Machinery.

Modern Shoe Manufacture. M. B. Kaven and J. B. Hadaway. Description of a modern shoe factory, the methods employed and the machinery used. Ills. 7500 w. Jour Am Soc of Mech Engrs—Dec., 1910. No. 19064 F.

Typewriters.

A Typewriter That Operates Without Noise. Illustrated detailed description of a machine, printing by pressure rather than by impact. 1200 w. Sci Am—Dec. 3, 1910. No. 19102.

MINING AND METALLURGY.

COAL AND COKE.

Accidents.

Mine Accident Prevention. J. J. Rutledge. Read before the Alabama Coal Operators Association. Considers organization and equipment for rescue work and the importance of efficient laws governing coal mining. 4000 w. Mines & Min—Dec., 1910. No. 19126 C.

Briquetting.

The Manufacture of Patent Fuel. Gives regulations issued by the Home Office to apply to the manufacture of patent fuel (briquettes) with addition of pitch. 1200 w. Col Guard—Dec. 2, 1910. No. 19322 A.

The Briquetting of Coal Dust. Lindon Bates, Jr. Illustrations and brief description of a Belgian process of great simplicity. 800 w. Sci Am Sup—Dec. 10, 1910. No. 19248.

Canada.

The Production of Coal and Coke in Canada During the Calendar Year 1909. Advance chapter of the annual report on the mineral production of Canada. 8000 w. Can Dept of Mines—1910. No. 19523 N.

China.

Native Coal and Iron Working in the Province of Shansi, China. Describes the deposits, tools used, and methods of mining. Plate. 2000 w. Engng—Dec. 2, 1910. No. 19325 A.

Coal Storage.

See Coal Handling, under MECHANICAL ENGINEERING, TRANSPORTING AND CONVEYING.

Coke Industry.

See Foundry Coke, under MECHANICAL ENGINEERING, MACHINE WORKS AND FOUNDRIES.

Coke Ovens.

Retort Coke Ovens in Mexico. E. B. Wilson. An illustrated account, reporting an increase in percentage of coke, as compared with the output of beehive ovens. 3500 w. Mines & Min—Dec., 1910. No. 19121 C.

Coking.

The Removal of Deposits of Graphite from the Riser Flues of By-Product Coke Ovens (Die Entfernung der Graphitansätze aus den Steigerohren der Koksöfen mit Nebenproduktengewinnung). A. Thau. Discusses the causes of graphite deposits and methods and arrangement of the installation for its easy removal. Ills. 3500 w. Glückauf—Nov. 19, 1910. No. 19683 D

Electric Power.

The Earthed Concentric System for Direct-Current Colliery Cables. W. Bolton Shaw. Considers the insulation of cables and the advantages of armaturing, describing the system named and discussing single and double concentric cables. 3500 w. Elect'n, Lond—Dec. 9, 1910. No. 19430 A.

Inspection and Repair of Electrical Plant Underground. R. R. Smith. Explains the system employed at the colliery with which the writer is connected. 2500 w. Ir & Coal Trds Rev—Dec. 2, 1910. No. 19455 A.

Mining Switchgear. H. W. Clothier. Before the Nat. Assn. of Colliery Mgrs. A record of experiences, with illustrated description of the leading features in the design of switchgear for mines. Short discussion. 4500 w. Ir & Coal Trds Rev—Dec. 16, 1910. No. 19707 A.

Explosions.

Chemistry of Coal-Dust Explosions Gives results of studies of dust explosions at the experiment station at Liévin, France. 3500 w. Mines & Min—Dec., 1910. No. 19123 C.

The Starkville, Colo., Explosion. Describes the method of mining and ventilating and the conditions before and after the explosion. 3300 w. Mines & Min—Dec., 1910. No. 19122 C.

India.

The Pench Valley Coalfield. F. I. Leslie Ditmas. Abstract of paper read before the N. of Eng. Min. & Mech. Engrs. Describes the deposits and the system of working. 2000 w. Ir & Coal Trds Rev—Dec. 16, 1910. No. 19705 A.

Mine Dust.

The Explosibility of Coal Dust. Reviews the history of past investigations of coal dust explosions and the work of the Mining Assn. of Great Britain. 3000 w. Engr, Lond—Dec. 9, 1910. Serial. 1st part. No. 19446 A.

The British Coal-Dust Experiments. Editorial review of the report of the first series of British coal-dust experiments. 3000 w. Engng—Dec. 9, 1910. No. 19444 A

Some French Experiments on Coal Dust. Henry Briggs. Abstract of a bulletin published in April, 1910, giving results of tests made to determine the underground conditions favorable to the production of a coal dust explosion. 7000 w Eng & Min Jour—Dec. 24, 1910. No. 19534.

Mine Fires.

Mine Fires. Thomas K. Adams. Read before the Min. Inst of Am. Draws lessons from fires past, and gives precautions necessary. 2500 w. Mines & Min—Dec., 1910. No. 19125 C.

Mine Gas.

Methods of Detecting Fire-Damp in Mines. Sir Henry H. Cunynghame. Gives a brief description of the principal methods of detecting fire-damp. Discussion. 5000 w. Jour Roy Soc of Arts—Nov. 25, 1910. No. 16169 A.

The Safety Lamp and the Estimation of Firedamp. George H. Winstanley. Abstract of paper before the Manchester Geol. & Min Soc. Discusses the use of safety lamps for the detection and estimation of firedamp. Ills. Also describes the "Contra" barometer. 4500 w. Col Guard —Dec. 16, 1910. No. 19592 A.

Mine Supplies.

Handling Mine Supplies. H. H. Fitch Read before the Coal Min. Inst. of Am. Explains the advantages of and methods for systematic handling. 9000 w. Mines & Min—Dec., 1910. No. 19124 C.

Mining.

Repair Work in Colliery Practice. James A. Seager. Suggestions that may save a colliery from a serious shutdown 2200 w. Eng & Min Jour—Dec. 10, 1910. No. 19264.

Prices.

Price Movements in the Coal, Iron, and Zinc Industries (Die Bewegung der Warenpreise im allgemeinen und der Preise für Kohle, Eisen und Zink im besondern). Lorenz Glier. A study of conditions in Germany. 7100 w. Glückauf—Nov. 5 1910. No. 19680 D.

Wales.

The Geological Structure of the Swansea Valley. Evan Ll. Davies. Read before the Nat. Assn. of Col. Mgrs. Descriptive. 4500 w. Ir & Coal Trds Rev—Dec. 2, 1910. Serial. 1st part. No. 19453 A.

Washing.

The Principles and Practice of Coal Washing. Prof. Henry Louis. Discusses its proper application, and the methods employed. 5500 w. Ir & Coal Trds Rev—Dec. 2, 1910. No. 19451 A.

See also Reinforced Concrete, under CIVIL ENGINEERING, Construction.

COPPER.

Alaska.

Chitina Valley Copper Deposits. E. Jacobs. Describes peculiarities of the country and deposits in Alaska made available by a new railroad. Ills. 5000 w. Mines & Min—Dec., 1910. No. 19131 C.

Arizona.

The Clifton-Morenci District of Arizona. William L. Tovote. This first article deals principally with the geology of these copper deposits. 3000 w. Min & Sci Pr—Dec. 10, 1910. Serial. 1st part. No. 19372.

Australia.

Notes on the Mount Morgan Ore Deposits, Queensland. J. Bowie Wilson. An account of the deposit as it appears today, with the writer's theory concerning its formation. Gives the early history of this gold mine, describes the geology of the district, and gives theories advanced to explain the deposit. Map & Ill. 6000 w. Inst of Min & Met, Bul. No. 74—Nov. 9, 1910. No. 19764 N.

Discussion on "Notes on the Mount Morgan Ore Deposits, Queensland." J. Bowie Wilson's paper is discussed. 4000 w. Inst of Min & Met, Bul. No. 75—Dec. 14, 1910. No. 19769 N.

Bessemer Process.

The Successive Stages in the Bessemerizing of Copper Mattes as Indicated by the Converter Flame. Donald M. Levy. Describes in detail the two main stages of bessemerizing copper mattes, illustrating by colored plates. 1700 w. Inst of Min & Met, Bul No. 74—Nov. 9, 1910 No. 19765 N.

Blast Furnaces.

An Improvement in Hot-Blast Copper and Lead Smelting. Clement H. Mace. Illustrates and describes a blast furnace invented by Allen R. Partridge, and its operation. 1200 w. Met & Chem Engng—Dec., 1910. No. 19301 C.

Blast-Furnace Slags.

Role of Alumina in Copper Blast Furnace Slags. L. Garrett Smith. Vogt's work is cited to prove that it acts as an acid only in slags rich in that mineral and as a base if silica is under 43 per cent. 2000 w. Eng & Min Jour—Dec. 24, 1910. No. 19533.

Bullion.

Moisture in Copper Bullion. Donald M. Siddell. A report of experimental tests for moisture, concluding that any bosh-cooled pig is likely to contain moisture. 1000 w. Eng & Min Jour—Dec. 3, 1910. No. 19090.

Congo.

The Copper Fields of the Southern Congo. History and information of the district and its development. Map. 3000 w. Min Wld—Dec. 17, 1910. No. 19408.

Converters.

Evolution of the American Copper Converter. Charles C. Christensen. Illustrated reveiew of types of copper converters and methods of different experimenters. 1500 w. Min Wld—Dec. 3, 1910. No. 19153.

Refining.

An Australian Electrolytic Copper Refinery. R. G. Casey, Jr. Describes the modern smeltery and refinery at Port Kembla. Ills. 3500 w. Eng Min Jour—Dec. 3, 1910. No. 19094.

Smeltery Gases.

A Process for Saving Wastes in Smeltery Gases. George C. Westby. Explains a process of treating finely divided slag while in suspension with the smelter gases, resulting in solution of the bases as thionates and sulphates. 5500 w. Eng & Min Jour—Dec. 10, 1910. No. 19262.

Smelting.

Pyritic Smelting in Leadville. Charles H. Doolittle and Royal P. Jarvis. Describes the process as carried out in the Bi-Metallic Smelter. 4500 w. Bul Am Inst of Min Engrs—Dec., 1910. No. 19716 F.

GOLD AND SILVER.

Alaska.

See Placers, under Gold and Silver.

British Guiana.

Origin of the Placer Gold of Guiana. Lee Fraser. Synopsis of a chapter in "Geology of the Goldfields of British Guiana," by J. B. Harrison. A résumé of the facts, hypotheses and theories. 2500 w. Min & Sci Pr—Nov. 26, 1910. No. 19075.

Cobalt.

The Progress of Cobalt. Joseph T. Maudy. The history, geology, ore deposits, etc., are dealt with in this first instalment. 3500 w. Min Jour—Dec. 10, 1910. Serial. 1st part. No. 19433 A.

See also Silver Milling, under Ore Dressing and Concentration.

Colombia.

Alluvial Gold Deposits and Mining in Colombia. P. A. Alig. Information concerning the production, the extent of the deposits, operating facilities and general conditions. 1500 w. Eng & Min Jour—Dec. 3, 1910. No. 19091.

Colorado.

See Gold Milling, under ORE DRESSING AND CONCENTRATION.

Cyaniding.

The Classification of Tailing Pulp Prior to Cyaniding. Edward H. Johnson. Reviews attempts made to produce a classified product, and gives experience gained with the continuous sand collecting system. Ills. 2000 w. Jour Chem, Met & Min Soc of S Africa—Oct., 1910. No. 19412 E.

Cyaniding in the Philippines. C. M. Eye. An illustrated review of methods. 3000 w. Far East Rev—Oct., 1910. No. 19204 N.

See also Gold Milling, under ORE DRESSING AND CONCENTRATION.

Dredging.

Kolchan Placer of the Orsk Goldfields, Ltd. Information, from reports by Purington and Hutchins, concerning this eastern Siberian dredging field. 2500 w. Eng & Min Jour—Dec. 7, 1910. No. 19392.

Mexico.

The Antigua Mines of Real de Sivirijoa, Sinaloa. E. A. H. Tayo. An account of a mine discovered in 1715 and worked for nearly a century. 2000 w. Eng & Min Jour—Dec. 10, 1910. No. 19259.

Minas Pedrazzini Operations Near Arizpe, Sonora. Edward L. Dufourcq. Describes deposits of high-grade silver ore in rhyolite, and evident secondary enrichment. 2200 w. Eng & Min Jour—Dec. 3, 1910. No. 19092.

Nicaragua.

The Gold Mining Industry in Nicaragua. T. Lane Carter. Gives information concerning conditions, mining laws, geology, labor, etc. Ills. 3000 w. Eng & Min Jour—Dec. 17, 1910. No. 19393.

Placers.

Nome Placer Mining. T. M. Gibson. Information concerning the work of the past season, and of a new find that may prove important. 1800 w. Min & Sci Pr—Dec. 17, 1910. No. 19504.

See also Dredging, under GOLD AND SILVER.

Refining.

Bullion Refining at Waihi G. M. Co. New Zealand. J. G. Goosman. Illustrated description of an electrolytic parting plant and oil furnace. 1800 w. Aust Min Stand—Oct. 26, 1910. No. 19338 B.

Russia.

See Dredging, under GOLD AND SILVER.

Spain.

The Silver-Bearing Veins of Hiendelaencina, Guadalajara, Spain. Vicente Kindelan. Describes the geology and vein system of the region, and reports operations in 1908. 1500 w. Min Jour—Dec. 17, 1910. No. 19586 A.

IRON AND STEEL.

Alabama.

The Hematitis of Alabama. J. Sharshall Grasty. Illustrated description of the iron ore deposits, with special reference to those of the Cambrian Age. 4000 w. Mfrs' Rec—Dec. 1, 1910. No. 19039.

Blast Furnace Air.

Determining Moisture in Air Blast. Clarence P. Linville. Describes a simple method of ascertaining the humidity of the air entering the stack. Ills. 1500 w. Ir Trd Rev—Dec. 29, 1910. No. 19777.

Blast Furnace Charging.

Progress in Blast-Furnace Charging Apparatus (Fortschritte auf dem Gebiete der Hochofenbegichtung). Describes some recent installations in Germany. Ills. Serial. 1st part. 2600 w. Stahl u Eisen—Nov. 2, 1910. No. 19664 D.

Blast Furnace Operation.

Some Calculations Pertaining to the Reactions Occurring in a Blast Furnace. W. D. Brown. Gives explanation of calculations, and also presents the results as formulae. 4000 w. Met & Chem Engng—Dec., 1910. No. 19299 C.

Investigations of the Material and Heat Balance of the Blast Furnace (Untersuchungen über die Stoff- und Wärmebilanz des Hochofens). W. G. Gillhausen. Works out the heat balance for four runs. Ills. 2800 w. Stahl u Eisen—Nov. 16, 1910. No. 19671 D.

Blast Furnaces.

New Plant at the Kettering Blast Furnaces. Plate and detailed description. 1500 w. Ir & Coal Trds Rev—Dec. 16, 1910. No. 19706 A.

Canada.

The Production of Iron and Steel in Canada During the Calendar Year 1909. Advance chapter of the annual report on the mineral production of Canada. 7000 w. Can Dept of Mines—1910. No. 19524 N.

China.

See same title, under COAL AND COKE.

Electrometallurgy.

First Norwegian Electric Steel Works Dr. Alfred Gradenwitz. Illustrates and describes an interesting application of the Hiorth system. 900 w. Sci Am Sup—Dec. 10, 1910. No. 19247.

The Electric Furnace in the Iron and Steel Industry (Der elektrische Ofen in der Eisen- und Stahlindustrie). Viktor Engelhardt. Describes the various furnaces, the extent of the industry, the cost of the electric process in comparison with other processes, etc. Ills. 7800 w. Zeitschr d Ver Deutscher Ing—Nov. 19, 1910. No 19840 D.

Ferro-Alloys.

The Ferro-Alloys Employed in the Manufacture of Iron and Its Products (Les Ferro-Alliages Employés dans la Fabrication du Fer et de ses Dérivés).

Cl. Berger. Describes briefly their manufacture, properties, and uses. 1500 w. Serial. 1st part. Rev Indus—Nov. 26, 1910. No. 19637 D.

Slowly Cooled Spiegeleisen (Ueber langsam erstarrtes Spiegeleisen). Bernhard Osann. Reports tests in spiegeleisen manufacture, the results of which offer valuable lessons for foundry practice. Ills. 2000 w. Stahl u Eisen—Nov. 9, 1910. No. 19668 D.

Germany.

The Iron-Ore Resources of Germany (Die Eisenerzvorräte des Deutschen Reiches). G. Einecke and W. Köhler. Describes three Bavarian deposits of iron ore. 2000 w. Stahl u Eisen—Nov. 2, 1910. No. 19665 D.

Great Britain.

The Iron-Ore Resources of the United Kingdom. Henry Louis. Abstracted from "The Iron Resources of the World." Vol. II. Considers the ores of the United Kingdom. 7000 w. Ir & Coal Trds Rev—Dec. 9, 1910. No. 19456 A.

Hot-Blast Stoves.

The Design and Heating Power of Hot-Blast Stoves (Berechnung und Wärmeausstrahlung steinerner Winderhitzer). A reply by Osann to Aldendorff's criticisms in *Stahl und Eisen* for July 27, 1910. with a rejoinder by Aldendorff. 5500 w. Stahl u Eisen—Nov. 23, 1910. No. 19674 D.

Mexico.

Iron-Ore Resources of Mexico. Ezequiel Ordonez. From a report submitted to the Nat. Geol. Cong. Information concerning extensive deposits, many at present inaccessible. 1200 w. Ir & Coal Trds Rev—Dec. 16, 1910. No. 19708 A.

Minnesota.

Iron Mining in Minnesota. E. K. Soper. Illustrated account of mining methods and production. 2200 w. Min & Sci Pr—Dec. 10, 1910. No. 19371.

Ore Dressing.

See Iron Ore, under ORE DRESSING AND CONCENTRATION.

Ore Resources.

The Iron-Ore Resources of the World (Die Eisenerzvorräte der Welt). W. Köhler. A review of the report to the International Geological Congress. Serial. 1st part. 4900 w. Stahl u Eisen—Nov. 16, 1910. No. 19669 D.

Plate Shears.

Hydraulic Plate Shears. Illustrated description of an interesting plant for shearing steel plates. 1000 w. Engr, Lond—Nov. 25, 1910. No. 19197 A.

Prices.

See same title, under COAL AND COKE.

Rolling Mills.

Development of the Universal Mill. B H. Reddy. Discusses the difficulties which beset the earlier designs and the improvements effected. Ills. 2000 w. Ir Trd Rev —Dec. 15, 1910. No. 19341.

The Spread of Iron in Finishing Rolls (Die Breitung des Eisens in Glattwalzen). Adolf Falk. A criticism of Scheld's theory of lateral extension. Ills. 4800 w. Stahl u Eisen—Nov. 23, 1910. No. 19672 D.

The Production of I Sections and Broad-Flanged Beams (Ueber die Herstellung von I-Eisen und breitflanschigen Trägern mit neigungslosen Flanschen). A discussion of rolls and rolling practice for producing these sections. Ills. 4800 w. Stahl u Eisen—Nov. 16, 1910. No. 19670 D.

See also Steel Works, under IRON AND STEEL; and Engines, under MECHANICAL ENGINEERING, STEAM ENGINEERING.

Spain.

Malaga Magnetites. F. Gillman. Further information concerning the ore deposits of the Malaga serpentines (Spain). Ills. 500 w. Inst of Min & Met, Bul No 75—Dec. 14, 1910. No. 19766 N.

Steel Making.

Recent Progress in the Metallurgy of Iron (Progrès Récents de la Sidérurgie). Henry Le Chatelier. A brief review of recent technical progress in the fabrication and use of iron and steel. 4800 w Rev Gen d Sci—Nov. 15, 1910. No. 19612 D.

Steel Works.

Electric Power in Steel Works and Rolling Mills. A series of tables giving the essential details of the equipment of generating plants and of electrically driven pumps, blowers, rolls, and cranes in Belgian steel works and rolling mills. Soc Belge d'Elecns—Oct., 1910. No. 19606 E

Tin Plate.

The Manufacture of Tin Plate (Die Fabrikation der Weissbleche). W. Krämer. A brief review of modern practice and apparatus. Ills. Serial. 1st part. 2300 w. Stahl u Eisen—Nov. 23, 1910 No. 19673 D.

LEAD AND ZINC.

Arizona.

Zinc Mines of the Hualapai District, Arizona. Newman B. Gregory. Describes the deposits and the development of this region. 1500 w. Min Wld—Dec. 24, 1910 No. 19560.

Colorado.

The Zinc-Carbonate Discoveries in Leadville. Gives information concerning this district and its mineral deposits, especially the discoveries recently made in ground thought to have been worked out. 2000 w. Min Wld—Dec. 17, 1910. No. 19409.

Lead Assaying.

The Determination of Lead in Non-Ferrous Alloys. C. P. Karr. Considers methods of assay applying to alloys into which lead enters in the course of foundry practice. 3000 w. Am Brass Found Assn—1910. No. 19011 N.

Lead Pigments.

The Mild Process of White Lead Manufacture. R. R. White. Explains the merits of this new process. 1500 w. Wis Engr—Dec., 1910. No. 19520 C.

Lead Smelters.

New Lead Smelters for Webb City, Missouri. Otto Ruhl. Illustration, with description of the fourth lead smelter for the Joplin district. 1200 w. Min Wld—Dec. 3, 1910. No. 19156.

Lead Smelting.

The Smelting of Lead-Antimony Ores. A. W. Hahn. Describes a small smeltery in Mexico smelting lead-antimony ores and making a saving at one operation of both the lead and antimony. 1000 w. Met & Chem Engng—Dec., 1910. No. 19306 C.

See also Blast Furnaces, under COPPER.

Prices.

See same title, under COAL AND COKE.

MINOR MINERALS.

Antimony.

See Lead Smelting, under LEAD AND ZINC.

Borates.

The Origin and Commercial Value of Borates. Gordon Surr. Information concerning borax and other borates. 2500 w. Min Wld—Dec. 17, 1910. No. 19407.

Cement.

A New Crescent Portland Cement Mill. Illustrated description of a new Plant in Pennsylvania. 2000 w. Eng Rec—Dec. 3, 1910. No. 19089.

The Manufacture of Portland Cement (La Fabbricazione del Cemento Portland). Considers the relative merits of dry and wet processes. Serial. 1st part. 2600 w. Il Cemento—Nov. 15, 1910. No. 19658 D.

Chromium.

The Distribution and Utilization of Chromium Ores. A *résumé* of information regarding this metal. 3000 w. Bul of Imp Inst—Vol. VIII. No. 3. Serial. 1st part. No. 19495 N.

Lime.

Methods of Manufacturing Hydrated Lime. Ernest McCullough. Information about this material and its making. 1500 w. Min Wld—Dec. 3, 1910. No. 19157.

Manganese.

Ferro-Manganese Value of Indian Manganese Ore. Abstracted from "The Manganese Ore Deposits of India," by L. Leigh Fermor. 2500 w. Ir & Coal Trds Rev—Nov. 25, 1910. No. 19200 A.

Mercury.

The Cinnabar Deposits of Terlingua, Texas. W. D. Hornaday. Illustrated account of this quicksilver district, and the one operating mine. 1400 w. Min Wld—Dec. 17, 1910. No. 19406.

Oil.

The Origin and Distribution of Petroleum. F. I. Wilbur. Reviews the theories generally accepted and gives opinions of mineralogists of note. 3000 w. Min Wld—Dec. 3, 1910. No. 19154.

Oil Losses by Fire. Charles A. Sidman. Illustration, with discussion of some causes of oil fires, and some methods of extinguishing them. 1000 w. Sci Am—Dec. 10, 1910. No. 19244.

Oilfields of Sakhalin. Constantine E. Pfaffius. Map and information concerning the extensive oil-belts. 1000 w. Mining Mag—Dec., 1910. No. 19738 B.

The Saghalien Oilfields. E. de Hautpick. Information concerning the mineral wealth of the island, especially the petroleum. 1000 w. Min Jour—Dec. 3, 1910. No. 19318 A.

The Taman Peninsula Oilfields (Northern Caucasus). E. de Hautpick. Describes the geology and gives details of the outcrops of petroleum-bearing strata. 1500 w. Min Jour—Dec. 17, 1910. No. 19585 A.

Phosphates.

A New Plant for the Production of Superphosphate of Lime. Plans and description of a plant for the economical production of artificial manures. 2000 w. Engr, Lond—Dec. 16, 1910. No. 19702.

Potash.

Germany's Great Potash Deposits and Mines. Robert J. Thompson. Illustrated article giving information of the deposits and their mining. 2000 w. Min Wld—Dec. 24, 1910. No. 19562.

Rubies.

The Ruby. Morris R. Ward. Information concerning the composition, color characteristics, methods of mining, and manufacture of artificial rubies. 2500 w. Mines and Min—Dec., 1910. No. 19132 C.

Sapphires.

The Sapphire Fields of Central Queensland. J. Stewart Nesbitt. Describes the country and gem fields, and the method of treating the material. 2200 w. Aust Min Stand—Oct. 26, 1910. No. 19339 B.

Tantalum.

On an Indirect Method for Determining Columbium and Tantalum. H. W. Foote and R. W. Langley. Explains method and gives results. 2500 w. Am Jour of Sci—Dec., 1910. No. 19728 D.

Note on a Recent Method for Separating Tantalum and Columbium. H. W. Foote and R. W. Langley. Considers the method proposed by Weiss and Landecker. 600 w. Am Jour of Sci—Dec., 1910. No. 19729 D.

Tin.

Notes on the Occurrence and Concentration of Tin Ores. C. Fred. Thomas. Describes the occurrence and production of tin, and modern practice at a plant in Cornwall for treating complex ore. 4000 w. Jour Chem, Met & Min Soc of S Africa—Oct., 1910. No. 19413 E.

Tin Sluicing in Tasmania. Edward Edwards. Explains the methods of prospecting and breaking down the ground, and the arrangement of sluices. Ills. 8000 w. Mines & Min—Dec., 1910. No. 19130 C.

Vanadium.

Notes on the Chemistry and Metallurgy of Vanadium. Warren F. Bleecker. Aims to give information intended to be accurate, and opinions of value. Deals with the chemistry of vanadium, vanadium analysis, and some new metallurgical methods. 6000 w. Met and Chem Engng —Dec., 1910. Serial. 1st part. No. 19300 C.

MINING.

Accidents.

Compensation for Industrial Accidents. David Ross. Discusses the resolution adopted by the Am. Min. Cong. at its Los Angeles meeting. 2500 w. Min & Sci Pr—Dec. 3, 1910. No. 19255.

Mine Accident Investigations. George S. Rice. Read before the Am. Min. Cong. Discusses the method of tabulation of accidents in metal and other mines suggested by the Bureau of Mines. 4000 w. Mines & Min—Dec., 1910. No. 19127 C.

Boring.

Oil-Well Drilling in California. William R. Jewell. A discussion of methods and costs. 1500 w. Min & Sci Pr—Dec. 10, 1910. No. 19373.

Drilling.

See Tunnelling, under MINING.

Education.

Old-Time Mining Schools and Mining. W. C. Wynkoop. A review of educational facilities in mining and metallurgy about fifty years ago. 1800 w. Min & Sci Pr—Dec. 3, 1910. No. 19253.

Electric Hoisting.

Electric Winding. J. C. Wilson. Address opening a discussion. Considers the distinguishing features, types of winders, arrangement, gearing, etc. Also discussion. Ills. 9500 w. Ir & Coal Trds Rev —Dec. 2, 1910. No. 19454 A.

Electrically-Driven Winding and Haulage Gears. Illustrated description of the plant constructed for operation in the shale mines at Linlithgow, N. B. 500 w. Engr, Lond—Dec. 9, 1910. No. 19449 A.

Electric Winders for Collieries. Reports an interesting discussion at Newcastle, introduced by J. G. Wilson. 6000 w. Col Guard—Dec. 2, 1910. Serial. 1st part. No. 19323 A.

Control of Electric Winding and Hoisting Engines. Dr. E. Rosenberg. Read before the Manchester Sec. of the Inst. of Elec. Engrs. Discusses the Ward-Leonard system and the rheostatic control of direct-current motors, and of induction motors, in the present number. Ills. 4000 w. Mech Engr—Dec. 16, 1910. Serial. 1st part. No. 19589 A.

Electric Winding, with Special Reference to its Development in Upper Silesia. Henry Moore Hudspeth. The economies resulting from its use are considered, and plants described. Also discussion. 8000 w. Ir & Coal Trds Rev—Dec. 16, 1910. No. 19704 A.

Electric Power.

Earthing of Electrical Apparatus. G. A. Webb. Discusses means for efficiently earthing underground electrical plant in mines, so as to minimize risk of accidents. Also suggestions as to earth indicators. 1400 w. Elect'n, Lond—Dec. 2, 1910. No. 19315 A.

Haulage.

See Electric Hoisting, under MINING.

Labor.

Handicaps of Rigid Working Hours. Discusses the effect of the Eight-Hour Act in Great Britain and why it is unpopular. 3000 w. Eng & Min Jour—Dec. 3, 1910. No. 19095.

Machinery.

The Substitution of Machines for Hand Labor in Mining (Der Ersatz des Handarbeiters durch die Maschine im Bergbau). Herr Kammerer. A review of the development of mining machinery of all classes. Ills. Serial. 1st part. 3500 w. Zeitschr d Ver Deutscher Ing—Nov. 5, 1910. No. 19834 D.

Methods.

A Revolution in Mining Methods. G. E. Wolcott. Explains a channeling method and its advantages. 3000 w. Min & Sci Pr—Nov. 26, 1910. No. 19076.

Mining and the Industrial Evolution R. B. Lamb. Considers the methods of the past, present and future. 4000 w. Can Min Jour—Dec. 15, 1910. No. 19459

Prospecting.

Prospecting in the North. Horace V. Winchell. Describes the region surrounding the Portland Canal as illustrating conditions north of the 40th parallel, compares them with conditions further south, and discusses the differences to be observed in ore deposits. 2000 w. Mining Mag—Dec., 1910. No. 19736 B.

Shaft Sinking.

Extension of a Colliery Working Shaft. M. S. Hachita. Gives details of cost and method used in sinking an old shaft. which was in constant use, to a lower level without stopping mining operations. Ills. 1200 w. Eng & Min Jour—Dec. 10, 1910. No. 19263.

Stowing.

Sand-Filling on the Witwatersrand. Contributions to the discussion of Edgar Pam's paper on this subject, giving details of the work. Ills. 3000 w. Jour Chem, Met, & Min Soc. of S Africa—Oct., 1910. No. 19414 E.

Surveying.

Mine Surveying Methods Employed at Butte, Mont. Paul A. Gow. An explanation of practice followed in this district. 2500 w. Eng & Min Jour—Dec. 17, 1910. No. 19394.

Tunnelling.

Fast Driving at the Goldfield Consolidated Mines. Claude T. Rice. Explains conditions under which the work was done, and the time and rate of drilling. 1200 w. Eng & Min Jour—Dec. 24, 1910. No. 19530.

ORE DRESSING AND CONCENTRATION.

Briquetting.

Iron Ore and Flue Dust Briquetting. Describes briefly the Schumacher and Ronay processes. Ills. 1200 w. Ir Age—Dec. 8, 1910. No. 19225.

Buddles.

The Buddle as a Concentrator of Copper Slimes. Claude T. Rice. A report of its use at the Ohio Copper mill, in Utah. Not understood by early millmen. Not adapted to the treatment of sands. Ills. 1500 w. Eng & Min Jour—Dec. 3, 1910. No. 19093.

Calcining Furnaces.

The Möller and Pfeifer Calcining Furnace (Kanalbrennofen von Möller und Pfeifer). W. Wollenweber. Describes a gas-fired furnace used in the Rhine-Westfalian coal district, Germany, for calcining argillite occurring in the coal seams for brick making. Ills. 2000 w. Glückauf—Nov. 5, 1910. No. 19679 D.

Chilian Mills.

Notes on Chilian Mills in Russia. H. C. Bayldon. Notes on the slow running "edge runner" mill used in Russia for crushing gold ores as a preliminary to amalgamation. Ills. 4500 w. Inst of Min & Met, Bul No. 75—Dec. 14, 1910. No. 19767 N.

Copper.

Designing a Thousand-Ton Concentrating Plant. Charles C. Christensen. Describes the method of planning a modern concentrating mill, representing the most recent practice in fine ore concentration, for treating a chalcopyrite ore. 1800 w. Min & Sci Pr—Dec. 17, 1910. No. 19503.

Electrostatic Separation.

Electrostatic Separation and Ore Dressing. F. S. McGregor. Abstract from paper read before the Elec-Chem Soc. Illustrated descriptions of plants and the scheme of separation. 2000 w. Min Wld—Dec. 3, 1910. No. 19155.

Gold Milling.

Reducing Mining Costs and Increasing Profits. Philip Argall. Address at banquet in celebration of the first month's run of the second unit of Stratton's Independence mill. Deals with the reduction made in cost of treatment of sulpho-telluride ores of the Cripple Creek District. 2000 w. Eng & Min Jour—Dec. 24, 1910. No. 19531.

Wasp No. 2 Cyanide Mill, Black Hills, S. D. Jesse Simmons. Illustrated description of the new cyanide mill which expects to achieve mining and milling at a cost of under a dollar a ton. 1200 w. Min Wld—Dec. 24, 1910. No. 19559.

See also Cyaniding, under Gold and Silver.

Grinding.

The Jackson Grinding-Mill. Illustrated description of a mill for pulverizing materials. 900 w Engng—Dec. 6, 1910. No. 19596 A.

Iron Ore.

Georgia Brown Iron-Ore Washeries. E. F. McCrossin. Illustrates and describes the methods of handling and cleaning the ore. 1700 w. Mines & Min—Dec., 1910. No. 19128 C.

Sampling.

Contribution to the Philosophy of Shipment Sampling. Joseph T. Mandy. A comparative analysis of hand and mechanical sampling. 4500 w. Can Min Jour—Dec. 1, 1910. No. 19168.

Silver Milling.

Hydrometallurgy of Cobalt Ores. Illustrates and describes the different methods of treatment as shown by flow sheets of the principal mills. 4500 w. Mines & Min—Dec., 1910. No. 19129 C.

Hydrometallurgical Operations at Cobalt. John Tyssowski. Thirteen operating mills treat over 1,000 tons per 24 hours. Ills. 3300 w. Eng & Min Jour—Dec. 24, 1910. No. 19532.

Slimes Treatment.

See Buddles, under Ore Dressing and Concentration.

MISCELLANY.

Australia.

The Progress and Prospects of Mining in Western Australia. A. Montgomery. Descriptive account of the country, the known mineral deposits, geological history, the value of the mines, opportunities for capital, etc. Discussion. 19000 w. Jour Soc of Arts—Dec. 9, 1910. No. 19410 A.

Chlorine.

The Origin of the Chlorine of the Ocean. Gordon Surr. Attributes the chlorine of the sea largely to volcanic agencies. 1500 w. Min Wld—Dec. 10, 1910. No. 19283.

Düsseldorf Congress.

The International Congress of Metallurgy at Düsseldorf (Le Congrès International de la Métallurgie à Düsseldorf). M. Arnou. An account of the proceedings of the metallurgical section, followed by abstracts of the papers read. Ills. 47500 w. Rev de Métal—Nov., 1910. No. 19611 E + F.

Geological Surveys.

Value of Geological Work in Limestone Regions. Claude T. Rice. Remarks on methods employed by different companies, and on the importance of obtaining reliable information of the underground geology. 3500 w. Eng & Min Jour—Dec. 10, 1910. No. 19261.

RAILWAY ENGINEERING.

CONDUCTING TRANSPORTATION.

Signaling.

Recent Developments in Signaling. A. H. Rudd. From a paper read before the Can. Ry Club. Discusses some of the problems concerning indications to be given. 3500 w. Ry Age Gaz—Dec. 23, 1910. No. 19510.

The Over-Running of Signals Standing at Danger. Mr. Hoogen. Trans. from *Zeit. des Ver. Deut. Eisenbahnverwaltungen.* Considers devices used to supplement visible signals. 4000 w. Bul Int Ry Cong—Nov., 1910. No. 19750 G.

An Improved Method of Producing Sound Waves for Signalling. Illustrates and describes apparatus for producing continuous or interrupted trains of sound waves which, when propagated by air or water, may be heard or detected in any known manner. 1500 w. Prac Engr—Dec. 2, 1910. No. 19316 A.

Detectors. A. H. Johnson. Read before the Inst. of Sig. Engrs. Considers the detection systems of railway signalling, and especially the advantages of electrical detection. Ills. 2000 w. Elec Engr, Lond—Dec. 9, 1910. No. 19419 A.

Train Speed.

High Speeds and Their Relation to Modern Practice in Railway Alignment. Charles F. Draper. Discusses the limitations of speeds on railway curves. Ills. 3500 w. Cassier's Mag—Dec., 1910. No. 19540 B.

MOTIVE POWER AND EQUIPMENT.

Air Brakes.

The Air-Brake as Related to Progress in Locomotion. Walter V. Turner. Reviews successive developments in train control apparatus, discussing principles, methods, and conditions of service. Ills. 8500 w. Jour Fr Inst—Dec., 1910. Serial. 1st part. No. 19720 D.

Blow at Distributing Valve Exhaust Port. A discussion of leakage in air-brakes. Ills. 1800 w. Ry & Loc Engng—Dec., 1910. No. 19149 C.

Car Journals.

The Proportions of Rolling-Stock Journals. T. Robson. Develops a formula by which the dimensions and surface speeds of journals can be fixed for different loads. 2500 w. Engng—Nov. 25, 1910. No. 19190 A.

Electrification.

Electric Railway Cost Estimating. H. M. Hobart. Read before the Arc Works Engng. Soc., England. Discusses the electrification of suburban service on steam roads, describing the estimation of costs for a hypothetical case. 5000 w. Elec Engr, Lond—Nov. 25, 1910. No. 19177 A.

Electrification of the New York Central Railroad. Edwin B. Katte. Abstract of a lecture at Sibley College. An illustrated description of the apparatus in the Port Morris Power Station, and other features of the work. 2500 w. Sib Jour of Engng—Nov., 1910. No. 19019 C.

The Electrification of the Detroit Tunnel. James Cooke Mills. Illustrated description of the installation of electric traction machinery. 3000 w. Cassier's Mag—Dec., 1910. No. 19541 B.

The Substitution of Electric Traction for Steam in the Boston Metropolitan District. Gives abstracts of reports made by the N. Y., N. H., & H. R. R. and the B. & A. R. R. 4500 w. Eng News—Dec. 8, 1910. No. 19243.

The Electrification of the Harton Coal Company's Railways and Shunting Yards. A. Schmit. Explains the reasons that led to the adoption of electricity, the advantages, etc., and gives an illustrated description of the installation. 4000 w. Ir & Coal Trds Rev—Dec. 2, 1910. No. 19450 A.

Freight Cars.

The Clark Quick-Dumping Steel Ore Car. James S. Martin. Illustrated detailed description with report of tests. 900 w. Eng News—Dec. 1, 1910. No. 19057.

Locomotive Balancing.

Counterbalancing the Driving Wheels of a 2-6-0 Locomotive. M. H. Westbrook. Gives data obtained while correcting the counterbalancing of an engine upon which several changes had been made. Ills. 1500 w. Mach (Ry Ed)—Dec., 1910. No. 19293 C.

Locomotive Boilers.

Experiments on the Influence of the Wade-Nicholson Arch on the Output of Locomotive Boilers. M. V. Gololobow. Deals with experiments carried out at the locomotive testing plant at the Poutilow works. 3500 w. Bul Int Ry Cong—Nov., 1910. No. 19749 G.

Locomotive Design.

Weight Equalization on Locomotive Wheels. G. M. Eaton. Explains the fundamental principles of the equalizing system and the performance of locomotives, 2000 w. Elec Jour—Dec., 1910. No. 19513.

Locomotive Evaporation.

Quality of Steam and Factor of Evaporation in Locomotive Tests. J. E. Gardner and L. W. Wilson. Gives curves worked out to determine the factors of evaporation based on 98.5 per cent. dry steam, with explanatory notes. 600 w. Ry Age Gaz—Dec. 16, 1910. No. 19374.

Locomotive Firebox.

Improved Firebox with Hollow Arch and Combustion Chamber. F. F. Gaines.

Illustrates and describes a design with a long fire-box, a combustion chamber and spark hopper, reporting test. 1500 w. Boiler Maker—Dec., 1910. No. 19298.

Water Tube Fire Boxes for Locomotives. Illustrated description of the Brotan water-tube boiler which has been successfully used in foreign countries, with notes on other water-tube arrangements. 2000 w. Am Engr & R R Jour—Dec., 1910. No. 19217 C.

Locomotive Flues.

Flue Failures. J. W. Kelly. Illustrated discussion of some of the causes, also the repairs and remedies. General discussion. 13000 w. Pro W Ry Club—Nov. 15, 1910. No. 19753 C.

Locomotive Journals.

See Car Journals, under Motive Power and Equipment.

Locomotive Operation.

Locomotive Fuel Economy. A. G. Kinyon. A discussion of possible improvements in economy in the supply of coal, condition of locomotives, use of the fuel, management of fires, etc. Also discussion. 15000 w. Pro Ry Club of Pittsburgh—Oct. 28, 1910. No. 19751 C.

Locomotives.

Mallet Locomotives for the Chesapeake & Ohio Railway. Illustrated description of a 2-6-6-2 engine designed to meet special conditions. 700 w. Am Engr & R R Jour—Dec., 1910. No. 19216 C.

Balanced Compound Atlantic Type Locomotives; Atchison, Topeka & Santa Fe. Describes recent changes in design of these locomotives, giving dimensions and illustrations. 500 w. Ry Age Gaz—Dec. 23, 1910. No. 19512.

Ten-Wheeled Locomotive for the Central Railroad of New Jersey. Illustrated description of one of ten engines for fast-freight service. They are hard coal burners with modified Wootten boilers. 700 w. Ry & Engng Rev—Dec. 10, 1910. No. 19285.

Recent Mallet Articulated Locomotives. Illustrates and describes designs for the St. Louis & San Francisco, and for the Chesapeake & Ohio. 1200 w. Ry Age Gaz—Dec. 16, 1910. No. 19375.

Heavy Power for the Hocking Valley Ry. Illustrates and describes new engines to replace the light-power formerly used. 500 w. Am Engr & R R Jour—Dec., 1910. No. 19218 C.

Consolidation Type for the Western Maryland Railway. Illustrated description of heavy locomotives for a line having heavy grades. 1000 w. Ry & Loc Engng—Dec., 1910. No. 19151 C.

The Great Western Railway. An illustrated review of the locomotive history of the Great Western broad gauge, and of subsequent developments on this railway. 3 plates. 25000 w. Engr, Lond—Dec. 16, 1910. No. 19599 A.

New Express Engines, North Saffordshire Railway. Illustrations and brief description of bogie engines for heavy service. 2500 w. Engr, Lond—Dec. 2, 1910. No. 19331 A.

The Paris-Lyons-Mediterranean Locomotive at the Brussels Exhibition. Plate, and illustrated description. 1000 w. Engng—Dec. 9, 1910. No. 19443 A.

New Baltic Type, Compound, Superheated Steam Locomotives. Charles R. King. Illustrated description of powerful locomotives for the Northern Railways of France. 2500 w. Mach (Ry Ed)—Dec., 1910. No. 19296 C.

Locomotives at the Brussels Exposition (Die Lokomotiven auf der Weltausstellung in Brüssel 1910). Herr Metzeltin. Begins a detailed description of the exhibits. Ills. Serial. 1st part. 8400 w. Zeitschr d Ver Deutscher Ing—Nov. 12, 1910. No. 19838 D.

Recent Types of Locomotives on the Belgian State Railways (Note sur les Types récents de Locomotives des Chemins de Fer de l'Etat Belge). Fernand Dubar. Describes three recent types, Nos. 9, 10, and 36. Ills. 2500 w. Tech Mod—Nov., 1910. No. 19617 D.

Class D Freight Locomotive with 200 Square Metres of Heating Surface on the Prussian-Hessian State Railways (Die D-Güterzuglokomotive mit 200 qm Heizfläche der preussich-hessischen Staatseisenbahnen). G. Hammer. Detailed description. Ills. 5000 w. Zeitschr d Ver Deutscher Ing—Nov. 26, 1910. No. 19843 D.

Locomotive Spark Arresters.

Van Horn-Endsley Spark Arrester. Illustrated description of the apparatus, with report of tests. 2500 w. Ry Age Gaz—Dec. 23, 1910. No. 19511.

Locomotive Superheating.

Superheaters. R. D. Lewis. Discusses the results of applying superheaters to locomotives, based upon tests made, using the Emerson superheaters. 1200 w. Wis Engr—Dec., 1910. No. 19519 C.

Locomotive Valve Gears.

The Lentz Poppet Valve Gear. Illustrates and describes a novel valve gear used by many foreign roads. 1500 w. Am Engr & R R Jour—Dec., 1910. No. 19219 C.

The Intercepting Valve and Its Operation Adapted from Bul. 1006 of the Am. Loc. Co. Illustrations and description showing the entire mechanism and the arrangement of the various steam pipes and passages, giving the intercepting valve in its four different positions. 3000 w. Ry & Engng Rev—Dec. 10, 1910. No. 19284.

Motor Cars.

The Suburban Service of the Great Western Railway and the Avoidance of Changing Locomotives from Front to Rear of Trains at the Paris-Nord Station

(Les Services de Banlieue du Great Western Railway et la Suppression des Manœuvres de Passage des Locomotives de Tête en Queue en Gare de Paris-Nord). Emile Bernheim. Describes the system of operation with steam motor cars arranged for distant control. Ills. 2000 w. Rev Gen d Chemins de Fer—Nov., 1910. No. 19614 G.

Problems.

Motive Power Problems. F. H. Clark. Address before the College of Engng, Univ. of Ills. A general discussion of problems of design, construction, maintenance, and operation. 3000 w. Ry & Engng Rev—Dec. 3, 1910. No. 19164.

Shops.

Care and Selection of Shop Equipment. Gives additional papers submitted by contestants in the recent competition on this subject. 6500 w. Ry Age Gaz—Dec. 2, 1910. No. 19115.

See also Shop Design, and Shop Practice, under MECHANICAL ENGINEERING, Machine Works and Foundries.

Snow Plows.

The Rotary Snow Plow. An illustrated article, reporting replies to questions sent to operating officials, concerning the efficiency of rotary plows. 4500 w. Ry Mas Mech—Dec., 1910. No. 19292.

Train Lighting.

The Brown, Boveri & Co. System of Electric Train Lighting (Eclairage électrique des Trains, Système Brown, Boveri et Cie). J. A. Montpellier. Describes the apparatus and electrical connections of the system. Ills. 2400 w. L'Elecn—Nov. 12, 1910. No. 19633 D.

NEW PROJECTS.

China.

Formal Opening of the British Section of the Kowloon-Canton Railway. Illustrated account of the opening of a line connecting Hong-Kong with the Chinese boundary, with information relating to it. 5000 w. Far East Rev—Oct., 1910. No. 19201 N.

The Canton-Hankow Railway. Discusses the question of foreign loans for the construction of this Chinese railway. Ills. 2500 w. Far East Rev—Oct., 1910. No. 19203 N.

Philippines.

Opening of the Iloilo-Capiz Line of the Philippine Railway Co. Brief illustrated account. 1000 w. Far East Rev—Oct., 1910. No. 19202 N.

Western Pacific.

The Western Pacific Ry. Information concerning this recently opened line extending from Salt Lake City to San Francisco, and of notable construction from both an engineering and an operating point of view. Map. 1000 w. Eng News—Dec. 1, 1910. No. 19053.

Winston-Salem Southbound.

North Carolina's Southbound Railway Enterprise. Fred A. Olds. An account of a three-million dollar railway, built in a year, and opened on Nov. 26. Ills. 2000 w. Mfrs' Rec—Dec. 1, 1910. No. 19037.

PERMANENT-WAY AND BUILDINGS.

Bridge Testing.

Impact Tests on Railway Bridges. Report of Committee XV—Iron and Steel Structures. An account of the work, with detailed results of tests, and discussion, etc. Tables and plates. Ills. 2500 w. Am Ry Engng & Main of Way Assn—Bul. 125. July, 1910. No. 19496 N.

Rail Joints.

Tests of Rail Joints. McLeod Thompson. Considers track conditions under a moving load, and the points that should govern the test, and points for observation during the test. Ills. 1500 w. Ry Age Gaz—Dec. 2, 1910. No. 19114.

Roundhouses.

An Excellent Locomotive Terminal. Illustrated detailed description of the terminal of the N. Y. C. & H. R. R. R. at Corning, N. Y. 5000 w. Am Engr & R R Jour—Dec., 1910. No. 19215 C.

Snowsheds.

Concrete and Timber Snowsheds on the Great Northern Ry. Illustrates and describes new protective work on the Cascade Division, which aims to carry across the line the snow that comes from the mountain slopes. 1200 w. Eng News—Dec. 15, 1910. No. 19360.

Terminals.

Railroad Construction Work at Louisville. G. D. Crain, Jr. Illustrates and describes extensive improvements in the terminal facilities, including a $2,000,000 bridge, $400,000 viaduct, yardage, etc. 3000 w. Mfrs' Rec—Dec. 15, 1910. No. 19342.

Tie Plates.

Tie Plates on American Railways. Gives drawings and statements of fact and opinion quoted from replies received to questions sent to railway engineers, with editorial discussion. 5800 w. Ry Age Gaz—Dec. 9, 1910. No. 19257.

Tunnels.

Report No. 5 on the Question of Long Railway Tunnels. Construction, Ventilaiton, and Operation. Rudolf Heine. Explains methods used on Alpine tunnels. Ills. 1700 w. Bul Int Ry Cong—Nov., 1910. No. 19748 G.

The Approaches to the La Salle Street Tunnel at Chicago. Explains difficulties and conditions and outlines the general design of the reconstruction of a double-bore tunnel and approaches. The design of the approaches is illustrated and described. 3000 w. Eng Rec—Dec. 24, 1910. No. 19563.

Turn Tables.

Electrically Operated Turn Tables. E. C. Wayne. Gives average operating conditions, showing the cost reduction effected by the use of electricity, and illustrating and describing the construction. 1800 w. Elec Jour—Dec., 1910. No. 19515.

TRAFFIC.

Freight.

Weak Links in the Chain. Henry Harrison Suplee. Discusses some defective points in transportation systems. 1600 w. Cassier's Mag—Dec., 1910. No. 19543 B.

Freight Rates.

Making Rates for a New Railway—An Object Lesson in Economics. Discusses conditions on the newly constructed "Northwest Line," a branch of the "Oregon Short Line," as an example. 2000 w. Ry Age Gaz—Dec. 16, 1910. No. 19378.

MISCELLANY.

Berlin.

The Traffic Problems of Greater Berlin (Die Verkehrsfragen des Wettbewerbs "Gross Berlin.") Herr Blum. Discusses the projects for the improvement of water and rail transportation (exclusive of rapid transit) submitted in a recent competition. Ills. 6600 w. Glasers Ann—Nov. 15, 1910. No. 19809 D.

Education.

See same title, under INDUSTRIAL ECONOMY.

Germany.

Five Years' Development of German Railways. Dr. W. Peters. Map, and description of the improvement in organization of the State railways, their extension, and details of rolling-stock improvements are given in the present article. 4500 w. Ry Age Gaz—Dec. 16, 1910. Serial. 1st part. No. 19377.

Operating Costs.

The Interstate Commerce Commission's Own Investigation of the Costs of Railway Operation. Gives analysis of cost compiled by the commission. Inset. 1000 w. Ry Age Gaz—Dec. 9, 1910. No. 19256.

STREET AND ELECTRIC RAILWAYS.

Brakes.

Syracuse Instruction Book. Information from this book with reference to the use of air-brakes. Ills. 1200 w. Elec Ry Jour—Dec. 17, 1910. No. 19369.

Canada.

Electric Railways in Canada. J. L. Payne. A general review of the financial standing, the equipment, and operation. 1800 w. Elec Ry Jour—Jan. 7, 1911. No. 19985.

Car Heating.

Recent Developments in Car Heating and Ventilation. H. S. Williams. Abstract of paper read before the Cent. Elec. Ry. Assn. Discusses the requirements and methods of obtaining the best results. 1800 w. Elec Ry Jour—Dec. 3, 1910. No. 19147.

Car Houses.

See Reinforced Concrete, under CIVIL ENGINEERING, CONSTRUCTION.

Car Lighting.

Tantalum Lamps on Chicago Railway Cars. Reports tests made which have resulted in their installation. 1800 w. Elec Ry Jour—Dec. 17, 1910. No. 19370.

Cars.

Center-Vestibule Steel Cars for the Oklahoma Railway Company. Illustrated description of steel cars of the prepayment center entrance and exit type. 800 w. Elec Ry Jour—Dec. 10, 1910. No. 19250.

Car Ventilating.

See Car Heating, under STREET AND ELECTRIC RAILWAYS.

Car Wheels.

Improvements in Street Car Wheels. S. M. Coffin. Abstract of paper read before the Ala. Light & Trac. Assn. Notes on the recent improvements and experience with steel wheels. 1200 w. Elec Ry Jour—Dec. 24, 1910. No. 19502.

Controllers.

Controllers for Electric Railways (Le Controle des Equipments de Traction électrique). H. Marchand. A study of methods and apparatus of control in the various systems of electric traction. Ills. Serial. 1st part. 2500 w. Tech Mod—Nov., 1910. No. 19619 D.

Costs.

See Electrification, under RAILWAY ENGINEERING, MOTIVE POWER AND EQUIPMENT.

Franchises.

Elements of a Constructive Franchise Policy. Delos F. Wilcox. Part of a paper read before the Nat. Munic. League discussing street railway franchises. 3000 w. Eng News—Dec. 8, 1910. No. 19232.

Germany.

The Electric Railways of Germany During the Year 1910. A general review of the service and matters related. 2000 w. Elec Ry Jour—Jan. 7, 1911. No. 19984.

Great Britain.

Electric Traction in Great Britain. A general review of existing lines, the problems, etc. 4000 w. Elec Ry Jour—Jan. 7, 1911. No. 19983.

Interurban.

Interurban Construction in the Central States During 1910. Gives a map of the Central States showing the location of interurban lines and review of progress in mileage. 1800 w. Elec Ry Jour—Jan. 7, 1911. No. 19982.

Locomotives.

The T. C. R. T. Locomotive. C. M. Jesperson. Describes a locomotive built for switching purposes, noticeable for its simplicity and its reversibility. 800 w. Minn Engr—Nov., 1910. No. 19761 C.

Recent Swiss Trunk-Line Electrical Locomotives (Beschreibung der hauptsächlichsten neueren schweizerischen Lokomotiven für elektrischen Vollbahn-Betrieb). Briefly describes important machines. Ills. 3500 w. Schweiz Bau—Nov. 5, 1910. No. 19692 B.

Long Island.

The New York & North Shore Traction Company. L. P. Crecelius and R. W. Emerson. Illustrated description of an electric railway system connecting the various towns and villages within the Long Island suburban district. 3500 w. Elec Ry Jour—Dec. 24, 1910. No. 19501.

Management.

Development of the Office of Superintendent of the Day, Boston Elevated Railway Company. Edward Dana. Gives details and methods of this office, developed in connection with special study of traffic conditions. 800 w. Elec Ry Jour—Dec. 3, 1910. No. 19144.

Monorail.

Monorail Gyroscope Railways (Zur Frage der Einschienenkreiselbahnen). Kurt Wiesinger. Briefly describes the systems and examines their possibilities. Ills. 4200 w. Elek Kraft u Bahnen—Nov. 14, 1910. No. 19821 D.

Motor Gears.

Wear of Railway Motor Gear and Pinion Teeth—Causes and Suggested Means of Relief. T. W. Williams. Abstract of paper read before the Cent. Elec. Ry. Assn. 1500 w. Elec Ry Jour—Dec. 3, 1910. No. 19146.

Municipal Control.

The Electric Railway Situation. Thomas N. M'Carter. Abstract of address before the New England Street Ry. Club. Discusses the public demands for regulating corporations. 3000 w. Elec Ry Jour—Dec. 31, 1910. No. 19782.

New York.

A Great Rapid Transit System for a Great City. Map and illustrations, with explanation of the proposed plan for doubling the capacity of New York City subways and elevated roads. 1700 w. Sci Am—Dec. 17, 1910. No. 19365.

Concerning "Good" Corporations and "Bad" Corporations, and How to Reform the Latter. Editorial discussion of the extension of the subways of N. Y. City and the two propositions under consideration. 2500 w. Eng News—Dec. 15, 1910. No. 19362.

Paris.

Public Transport Systems in Paris. Map and information concerning the new municipal system of tramways and the revision of the omnibus system. 2500 w. Tram & Ry Wld—Dec. 8, 1910. No. 19500 B.

Power Plants.

See Central Stations, and Hydro-Electric, under ELECTRICAL ENGINEERING, GENERATING STATIONS.

Railless.

Railless Electric Traction Systems (Elektrische Automobilstrecken mit Oberleitung). H. Maurer. Briefly describes the Daimler system. Ills. 2500 w. Schweiz Bau—Nov. 12, 1910. No. 19693 B.

Shops.

New Shops of Utah Light & Railway Company. An illustrated account of the shops under construction and other improvements. 1000 w. Elec Ry Jour—Dec. 10, 1910. No. 19249.

Signaling.

Automatic Block Signals and Train Stops on Single Track Interurban Line of the Washington Water Power Company. Illustrated description of the installation of a complete alternating-current signal system. 3500 w. Elec Ry Jour—Dec. 17, 1910. No. 19368.

Subways.

See same title, under CIVIL ENGINEERING, CONSTRUCTION; and New York, under STREET AND ELECTRIC RAILWAYS.

Three-Phase.

Three-Phase Trunk Lines in Europe (Drehstromvollbahnen in Europa). R. E. Hellmund. A general discussion of three-phase traction practice. Ills. 3400 w. Elektrotech u Maschinenbau—Nov. 13, 1910. No. 19827 D.

Track Reconstruction.

Double Tracking and Grade Revision on an Interurban Electric Railway. Luther Dean. Illustrates and describes the revision of a part of the line between a city and a pleasure park, to facilitate the safe handling of heavy traffic. 2000 w. Eng News—Dec. 15, 1910. No. 19356.

Track Standards.

Track Department Standards of New York State Railways. Gives standard designs of track and right-of-way structures recently adopted by Rochester interurban lines. Ills. 1000 w. Elec Ry Jour—Dec. 3, 1910. No. 19145.

Train Operation.

Operating a Long Island Railroad Motor Train. W. B. Kouwenhoven. Directions and suggestions for operating and for meeting emergencies. Ills. 2500 w. Ry & Loc Engng—Dec., 1910. No. 19150 C.

Valuation.

The Basis of Valuation in Case of Municipal Purchase of Street Railways. Sidney Ossoski. Discusses methods of valuation used at Chicago and Cleveland, as examples. 2500 w. Elec Ry Jour—Nov. 12, 1910. No. 18465.

EXPLANATORY NOTE—THE ENGINEERING INDEX

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language,* together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cts. The letter A, B, or C denotes a price of 40 cts.; D, of 60 cts.; E, of 80 cts.; F, of $1.00; G, of $1.20; H, of $1.60. When the letter X is used it indicates that copies are not readily obtainable and that particulars as to price will be supplied on application. Certain journals, however, make large extra charges for back numbers. In such cases we may have to increase proportionately the normal charge given in the Index. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

Serial publications are indexed on the appearance of the first instalment.

SPECIAL NOTICE.—To avoid the inconvenience of letter-writing and small remittances, especially from foreign countries, and to cheapen the cost of articles to those who order frequently, we sell coupons at the following prices:—20 cts. each or a book of twelve for $2.00; three books for $5.00.

Each coupon will be received by us in payment for any 20-cent article catalogued in the Index. For articles of a higher price, one of these coupons will be received for each 20 cents; thus, a 40-cent article will require two coupons; a 60-cent article, three coupons; and so on. The use of these coupons is strongly commended to our readers. They not only reduce the cost of articles 25 per cent. (from 20c. to 15c.), but they need only a trial to demonstrate their very great convenience—especially to engineers in foreign countries, or away from libraries and technical club facilities.

Write for a sample coupon—free to any part of the world.

CARD INDEX.—These pages are issued separately from the Magazine, printed on one side of the paper only, and in this form they meet the exact requirements of those who desire to clip the items for card-index purposes. Thus printed they are supplied to regular subscribers of THE ENGINEERING MAGAZINE at 10 cents per month, or $1.00 a year; to non-subscribers, 25 cts. per month, or $3.00 a year.

THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the index. In the list below, *w* indicates a weekly publication, *b-w,* a bi-weekly, *s-w,* a semi-weekly, *m,* a monthly, *b-m,* a bi-monthly, *t-m,* a tri-monthly, *qr,* a quarterly, *s-q,* semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated; W—Words; Anon—Anonymous.

Alliance Industrielle. *m.* Brussels.
American Architect. *w.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Jl. of Science. *m.* New Haven, U. S. A.
American Machinist. *w.* New York.
Anales de la Soc. Cien. Argentina. *m.* Buenos Aires.
Annales des Ponts et Chaussées. *m.* Paris.
Ann. d Soc. Ing. d Arch Ital. *s-m.* Rome.
Architect. *w.* London.
Architectural Record. *m.* New York.
Architectural Review. *s-q.* Boston.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Melbourne.
Autocar. *w.* Coventry, England.
Automobile. *w.* New York.
Automotor Journal. *w.* London.
Beton und Eisen. *qr.* Vienna.
Boiler Maker. *m.* New York.
Brass World. *m.* Bridgeport, Conn.
Brickbuilder. *m.* Boston.
Builder. *w.* London.
Bull. Bur. of Standards. *qr.* Washington.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bull. of Can. Min. Inst. *qr.* Montreal.
Bull. Soc. Int. d'Electriciens. *m.* Paris.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bull. Int. Railway Congress. *m.* Brussels.
Bull. Scien. de l'Assn. des Elèves des Ecoles Spéc. *m.* Liége.
Bull. Tech. de la Suisse Romande. *s-m.* Lausanne.
California Jour. of Tech. *m.* Berkeley, Cal.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *w.* Toronto and Montreal.
Canadian Mining Journal. *b-w.* Toronto.
Cassier's Magazine. *m.* New York and London.
Castings. *m.* Cleveland, O.
Cement. *m.* New York.
Cement Age. *m.* New York.
Central Station. *m.* New York.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Colliery Guardian. *w.* London.
Commercial Vehicle. *m.* New York.

Compressed Air. *m.* New York.
Cornell Civil Engineer. *m.* Ithaca.
Deutsche Bauzeitung. *b-w.* Berlin.
Die Turbine. *s-m.* Berlin.
Domestic Engineering. *w.* Chicago.
Economic Geology. *m.* New Haven, Conn.
Electrical Age. *m.* New York.
Electrical Engineer. *w.* London.
Electrical Engineering. *w.* London.
Elec. Review and W. Elec'n. *w.* Chicago.
Electrical Review. *w.* London.
Electric Journal. *m.* Pittsburg, Pa.
Electric Railway Journal. *w.* New York.
Electrical World. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.
Elektrische Kraftbetriebe u Bahnen. *w.* Munich.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnik u Maschinenbau. *w.* Vienna.
Elektrotechnische Rundschau. *w.* Potsdam.
Elettricità. *w.* Milan.
Engineer. *w.* London.
Engineering. *w.* London.
Engineering-Contracting. *w.* New York.
Engineering Magazine. *m.* New York and London.
Engineering and Mining Journal. *w.* New York.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penna. *m.* Pittsburg, U. S. A.
Far Eastern Review. *m.* Manila.
Foundry. *m.* Cleveland, U. S. A.
Génie Civil. *w.* Paris.
Giesserei-Zeitung. *s-m.* Berlin.
Glasers Ann. f Gewerbe & Bauwesen. *s-m.* Berlin.
Heating and Ventilating Mag. *m.* New York.
Horseless Age. *w.* New York.
Ice and Cold Storage. *m.* London.
Ice and Refrigeration. *m.* New York.
Il Cemento. *s-m.* Milan.
Industrial World. *w.* Pittsburg.
Ingegneria Ferroviaria. *s-m.* Rome.
Ingenieur. *w.* Hague.
Insurance Engineering. *m.* New York.
Int. Marine Engineering. *m.* New York.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron Trade Review. *w.* Cleveland, U. S. A.
Jour. of Accountancy. *m.* N. Y.
Journal Am. Soc. of Engineering-Contractors. *m.* New York.
Journal Asso. Eng. Societies. *m.* Philadelphia.
Journal Franklin Institute. *m.* Philadelphia.
Jour. N. E. Water Works Assn. *qr.* Boston.
Journal Royal Inst. of Brit. Arch. *s-q.* London.
Jour. Roy. United Service Inst. *m.* London.
Journal of Sanitary Institute. *qr.* London.
Jour. of South African Assn. of Engineers. *m.* Johannesburg, S. A.
Journal of the Society of Arts. *w.* London.
Jour. Transvaal Inst. of Mech. Engrs., Johannesburg, S. A.
Jour. of U. S. Artillery. *b-m.* Fort Monroe, U. S. A
Jour. W. of Scot. Iron & Steel Inst. *m.* Glasgow.
Journal Western Soc. of Eng. *b-m.* Chicago.
Jour. of Worcester Poly. Inst., Worcester, U. S. A.
Locomotive. *m.* Hartford, U. S. A.
Machinery. *m.* New York.
Manufacturer's Record. *w.* Baltimore.
Marine Review. *m.* Cleveland, U. S. A.
Mechanical Engineer. *w.* London.
Mechanical World. *w.* Manchester.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Metallurgical and Chem. Engng. *m.* New York.
Métallurgie. *w.* Paris.
Metal Worker. *w.* New York.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci. Press. *w.* San Francisco.
Mining Journal. *w.* London.
Mining Magazine. *m.* London.
Mining World. *w.* Chicago.
Mittheilungen des Vereins für die Förderung des Local- und Strassenbahnwesens. *m.* Vienna.
Municipal Engineering. *m.* Indianapolis, U. S. A.
Municipal Journal and Engineer. *w.* New York.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Oest. Wochensch. f. d. Oeff. Baudienst. *w.* Vienna.
Oest. Zeitschr. Berg- & Hüttenwesen. *w.* Vienna.
Power and The Engineer. *w.* New York.
Practical Engineer. *w.* London.
Pro. Am. Ins. Electrical Eng. *m.* New York.
Pro. Am. Ins. of Mining Eng. *m.* New York.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Pro. Am. Soc. Mech. Engineers. *m.* New York.
Pro. Canadian Soc. Civ. Engrs. *m.* Montreal.
Proceedings Engineers' Club. *qr.* Philadelphia.
Pro. Engrs. Soc. of Western Pennsylvania. *m.* Pittsburg.
Pro. St. Louis R'way Club. *m.* St. Louis, U. S. A.
Pro. U. S. Naval Inst. *qr.* Annapolis, Md.
Progressive Age. *s-m.* New York.
Public Works. *qr.* London.
Quarry. *m.* London.
Queensland Gov. Mining Jour. *m.* Brisbane, Australia.
Railway Age Gazette. *m.* New York.
Railway and Engineering Review. *w.* Chicago.
Railway and Loc. Engng. *m.* New York.
Railway Master Mechanic. *m.* Chicago.
Revue d'Electrochimie et d'Electrométallurgie. *m.* Paris.
Revue de Mécanique. *m.* Paris.
Revue de Métallurgie. *m.* Paris.
Revue Gén. des Chemins de Fer. *m.* Paris.
Revue Gén. des Sciences. *w.* Paris.
Revue Industrielle. *w.* Paris.
Rivista Marittima. *m.* Rome.
Rudder. *m.* New York.
Schiffbau. *s-m.* Berlin.
School of Mines Quarterly. *q.* New York.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Sibley Jour. of Mech. Eng. *m.* Ithaca, N. Y.
Signal Engineer. *m.* Chicago.
Soc. Belge des Elect'ns. *m.* Brussels.
Stahl und Eisen. *w.* Düsseldorf.
Stevens Institute Indicator. *qr.* Hoboken, U. S. A.
Surveyor. *w.* London.
Technique Moderne. *m.* Paris.
Tramway & Railway World. *m.* London.
Trans. Inst. of Engrs. & Shipbuilders in Scotland, Glasgow.
Wood Craft. *m.* Cleveland, U. S. A.
Yale Scientific Monthly. *m.* New Haven.
Zeitschr. f. d. Gesamte Turbinenwesen. *w.* Munich.
Zeitschr. d. Mitteleurop. Motorwagen. Ver. *s-m.* Berlin.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschr. f. Werkzeugmaschinen. *b-w.* Berlin.

THE
ENGINEERING MAGAZINE
"THE WORLD IS ITS FIELD"

VOL. XL. MARCH, 1911. No. 6.

MONOPOLY AND PROGRESS.

By Dr. Franz Erich Junge-Hermsdorf.

III. STATE POWER AND ITS RELATION TO INDUSTRIAL POLICY IN GERMANY.

In this issue Dr. Junge brings to a close, for the present, his remarkable comparative study of American and German industrial policies and methods. His insight into affairs is obtained by thorough knowledge of his subject. His interpretation of German institutions, while inspired by the true affection of a patriot, acknowledges clearly the influence of special conditions and traditions upon their efficacy, and the limits to their application elsewhere. With these admissions, he suggests their possible adaptation to the certainly difficult situation confronting the manufactures and commerce of the United States.—THE EDITORS.

NOTHING common to man is foreign to nations. The story of the prodigal son applies to families as well as to communities. Thus in every people there is a natural inclination to prodigality, but not every nation has a benevolent father ready to kill a fatted calf, if waste and destruction have depleted its natural inheritance. Germany is not a rich man's heiress. She must prepare her children for adversity, not for prosperity, must fit them for the lean years which are near, not for the fat years that are promised in the future. Thus and thus only will they be able to conquer the racking times which are approaching.

Hence to the prime rule of *strategic expediency* dominating our national household, is coupled the other no less important consideration of *national economy,* urging upon authorities the supreme duty of guarding the country's irreplaceable resources, material and other, which joined with the subtle factor of civic virtue are the pillars of every commonwealth. Having to support sixty-five million active people on a territory four-fifths the size of Texas, and being fully aware of our geographical limitations, of the precariousness of our central situation, of the scarcity of raw materials at our avail, of our dependence for certain supplies on foreign markets, and of the fact that in times of war they will be cut off by our adversaries—scientific administration and rational utilization of materials, emancipation from foreign support, the development of high-grade industries and agriculture, and the exchange of grey matter for raw matter, are natural correctives of our limited opportunities and logical directives for the industrial and commercial policy of the Empire.

Leaving aside the political argument and speaking more particularly of the attitude of the State, the present policy of Germany can be shortly defined as one of mutual partnership or co-operative nationalism, the State and its government attending to the more general and ideal, and the private individual to the more special and material ends of the national business. In spite of democracy pressing from without and of evolutionary philosophy pressing from within, there is a growing tendency on the part of the masses to rely on the State for support and inspiration, making the national government both co-active and co-responsible for their welfare. And even among conservative statesmen, the leaning, today, is far more in the direction of State socialism than in the direction of democracy.

This leaning on the paternal State is not wholly the result of modern tendencies. It is a result, in part, of the traditional policy of the Hohenzollern, radiating from Prussia ever since they took over the control of affairs in that country. It was the proud boast of Frederick the Great that he was *le roi des gueux*. Of all the governments of the seventeenth century, the Prussian was the first to seek the welfare of the whole community. The "Landrecht" recognizes the State as the protector of the poorer classes, and the supply of sustenance and work for those lacking means and opportunity of earning a livelihood as one of its duties. It was upon these clauses that Bismarck relied when, on May 7, 1884, he declared to the Reichstag his recognition of the laborers' right to work. His idea of social reform, of the nationalization of railways, of State monopolies in brandy and tobacco (not realized), even of the return to protection, all spring from his profound conviction that "many measures which we have adopted to the great blessing of the country are socialistic, and the State will have to accustom itself to a little more socialism yet." (1882.)

In this age of monopoly, when under the sway of commercialism the empire of business in all countries is encroaching upon national Governments, anxious to seize their privileges without burdening itself with their responsibilities, the blessing of a paternal policy for the weal of the State is making itself especially felt. In reflecting upon American conditions, in this relation, it should be borne in mind—as distinguishing between our respective constitutional confederate systems—that in Germany every one of the twenty-six States is really a sovereign agency rendering public service, not merely "a government or administrative district" (W. Willoughby).

In Germany transfer of function from State to Federal authority means no more than a change in the site of the authority. The same functionaries who acted under State authority continue to act under Federal authority. Whether State or Nation should serve as public agency is, therefore, only a question of administrative expediency, not of principle rights. History and Constitution provide both Federal and State governments with adequate powers to cope with and regulate, in the name of the sovereign nation itself, the empire of business; while in the United States, business has become a power as great and greater than the nation in its scope and consequence—"a colossus which stands amid a confused variety of States and statutes, uniform, concentrated, poised upon a single plan, governed not by votes but by commands, seeking not service but profits." (Woodrow Wilson.)

In Germany private monopoly could never reach such gigantic proportions, because at the very outset of the industrial age a big slice of the national assets was withdrawn from private enterprise by the Government, being reserved exclusively for public uses and operated on a strictly socialistic basis for the equitable good of all. The other and major portion of the basic resources was, of course, left to exploitation and improvement by private initiative. In the course of time and under the influence of the economic revolutions in the neighboring European countries, especially England (Smith) and France (Colbert), the attitude of the State towards industry has, naturally, undergone various changes. But today the general tendency, under the pressure of the socialistic vote, is stronger than ever before for an expansion of national coöperation under the leadership of State or national government—representing a compromise, as it were, between the mercantilistic and the physiocratic doctrines, between the individualist and collectivist schemes—an attempt to infuse the cold reasoning of reckless commercialism and the utopian dreams of extreme socialism with the nobler motives of national expediency.

While the *authority* of the State is invariably supreme, its *functions* are of the progressive variety, establishing the balance between all the productive and destructive forces of the land. The State not only partakes in every form of private industry, engaging part of the three factors of production—nature, labor and capital—but it extends its intervention in proportion to the growing needs of the Commonwealth. Its functions of *service* are quite as marked as its functions of *restraint,* and, with the standard of German citizenship on the ascendant, there is, indeed, a tendency of diminishing restraint and of increasing service.

Concisely defined, the State has to perform the following internal activities: (1) the framing of special laws serving various economic needs (agricultural, industrial, commercial, financial, banking, trades, etc), and the adjustment of the general and more especially of the civil law to these measures; (2) the performance of acts serving to eliminate obstacles or restraints hampering individual, associated, or other activity, and provision of measures fostering productivity, commerce, trade at home and abroad, whenever the efforts of individuals or groups fail to bring about the desired effect; (3) the taking over of business enterprises by the State or by communities, as far as these enterprises cannot be efficiently operated by private action, or are apt to lead to plundering of the public and other disastrous results; (these include the postal service, comprising telegraphs, telephones, parcels post; and further, railroads, a number of mines, smelting plants, factories, mills, forests, and farms); (4) the enactment of legal provisions for the protection of the poorer classes against extortion by the richer, of consumers by producers, and for the general betterment of the people's welfare (factory legislation, workingmen's insurance against sickness, accident and old age, inspection of houses, of food, regulation of competition, the State co-operating as far as possible with private philanthropic institutions).

Nor are the above all the functions which the State in Germany has to perform. Its powers, it was said, are progressive and practically unlimited. If higher political interests should so demand, the State may nullify any act of the people or of the people's representatives, may cancel even private property—with due compensation of the owners—if the public and human rights of the situation are deemed superior in sanctity to fixity of tenure. ("Staatsnotrecht.") In short, the State government in Germany is equalled in power and irresponsibility only by the judiciary (Supreme and Commerce Courts) of the United States. Those interests, be they aristocratic or plutocratic, which control the composition of either body, dominate the country, it being immaterial whether we call ourselves monarchical or democratic.

From the Middle Ages on, when imperialism was changed to nationalism, and more especially since 1850, when constitutional government was established in Prussia, the political influence exercised from the many up is quite as marked as the influence from the one down. The latter is indispensable because we do not care to impair the homogeneity of our race by foreign influx, and because the great mass of our people are a slow-acting body, needing direction and stimulus in order to move. It is amusing for one who possesses comparative insight to hear foreigners talk of "tyrannical domination" and "one-man power" in Germany, where property and capital are so much more equitably distributed than anywhere else, and where every one of our later-day reforms savors of socialism. In fact, even the emancipation of the peasantry, which was inaugurated as a result of the Stein-Hardenberg legislation—being an agrarian reform when the State took land from one person and gave it to another—was a much stronger form of state-socialism than was any of the above mentioned Bismarckian reforms, or as would be, for example, a complete nationalization of the mining industries.

The question of conservation and economy in the administration and utilization of irreplaceable resources being the dominant issue of the hour in the Union, and surely one of the gravest questions for the life of any nation, it is important to study the attitude of the State toward this concrete problem somewhat more closely. All mineral resources in the German Empire are "regalia," as they once were in the Roman Empire, it being the prerogative of the State to preserve or to exploit the mineral treasures of the land in a manner and at a rate best suited to the common concern. While the attitude of the State in this relation may change—for instance, a leasing system being preferred at one time and a selling system at another, as industrial conditions may require—the State yet always possesses the regal ownership of these resources—the right to take alike by escheat and forfeiture, the title to legislate in a manner which will reserve the exclusive right of the production and sale of minerals to the public, if private enterprise should disregard national needs, stand as a bar to progress, or, in any way, operate against the best interests of the public.

Thus on June 18, 1907, a law was passed in Prussia reserving the searching and mining of coal and salts exclusively to the State. On May 25, 1910, the now famous "Kali law" was enacted, regulating the production, delivery, and price of potash salts, and there are, of course, quite a number of laws pertaining to the social side of mining industries, because mine workers, on account of the special hardships and dangers to which they are exposed, deserve the special care of a beneficent government.

Now, if the State owns and produces a sufficient percentage of some commodity, for instance, the coal, the Government can, of course, regulate and control the market, preventing cornering, demoralization, and slaughtering of prices, by offering its products at a lower price than the syndicate or withdrawing them from the market, as the case may be. Unfortunately, in the case before us, the Prussian State produces only about 20 million tons, or 10 per cent of the total output of coal, an amount which is almost completely absorbed in State iron and steel works, railroads, the navy, and other public institutions; so that regulation by competition is impossible unless the sphere of the State's activity is extended.

This policy of extending the State's activity as a supplier of raw materials commends itself for various reasons. It is technically practicable, commercially feasible, and financially profitable. It increases the controlling power and the stable revenues of the Government, without necessitating the levying of new taxes on the people, for which it is always hard to find a majority. But whether the immediate future in my country, under the pressure of socialism, will see more competition between public and private enterprises, or whether, under the pressure of capital, Government will limit its interference to an extension of control of private business by multiplication of statutes, cannot now be foretold. Personally I prefer the first mode to the second, because the latter must inevitably lead to a multiplicity and complexity of laws, which is already a crying nuisance of our generation, resulting in a general disregard of the sanctity and authority of the law.

This conviction is deepened when we contrast with the above outlined system of conservation and operation in Prussia, the chaos of uncertainties which seems to exist in the legal jungle of the United States, especially in the land and mining laws. Here is rich spoil for lawyers and corporations who fatten under their rule, defeating —by a bewildering contrariety of conflicting decisions—every effort on the part of the people to amend existing evils, and making a radical reform impossible as long as the vested rights and contracts of corporations are deemed superior in sanctity to the public weal, and as long as the destructive controversy of "State versus National rights" absorbs all constructive energy of executive circles.

Even though the Federal government has succeeded in withdrawing an enormous tract of land, amounting in some States to over half of the total acreage, from public entry, the mere reservation of resources seems of no use, and may be directly a bar to the development of certain sections of the country, unless it is supplemented by an adequate system of *operation* under State control. But then, again, American experts have little faith in the ability of government even as a legislator. Says Dr. R. W. Raymond of New York: "An overruling providence has saved our State from the results of absurd legislation in this respect by withholding from it, so far as is now known, any considerable deposits of those minerals to which the most archaic, confused, impracticable and absurd provisions of its mining laws would apply."

In view of these facts, I am satisfied to believe that the German system, though not perfect, is in every way superior to the American plan. More beneficent, more scientific, and more practical in a national economic sense, restraining private initiative and cutting the profits of private enterprises, but, on the other hand, distributing the earnings of capital more equitably among the people, the German system is at least definite and clear as to the scope and operation of the law; it is uniform in concentrating disconnected impulses in one direction, and it has in it none of the elements of uncertainty and of dependence on demagogism, which prove so disturbing to the stability and continuity, and last, not least, to the *credit*, of enterprises in the United States.

Of course, it should be acknowledged at once that the success of the German system of administration and operation depends entirely upon the moral and intellectual qualities possessed by the Government. It stands and falls with decent officialdom. If the bureaucracy ever become commercialized and corrupt, if public servants ever place the striving for gain above the striving for honor, then the whole system grows rotten and, perhaps, worse than private monopoly. And here our foreign friends will readily see, in passing, why absolute obedience to the law, speediness in the administration of justice, strict discipline in the country's service, are so essential for us; why we esteem next to the warrior, and in order of public regard rank second only to the administrator, the executor of the law, honoring and elevating high above commercial shrewdness, mechanical ingenuity, and legal talent—which can be bought—righteousness and fidelity and character, which are the pillars of public ownership and operation.

It is a notorious fact often lost sight of by Americans that public enterprise, being easily reached and quickly held to account by public criticism, tends to develop a high-minded and even effective class of public servants, their inferiority in commercial subtlety being counterbalanced by their superiority in administrative morality, which is, after all, a mightier factor in national efficiency than all the other factors combined. Yet while the system of public ownership and control works very well in Germany, all points considered, it is questionable whether—if it could be introduced—it would work well in the United States. In the "Gopher Commonwealth," where mineral resources are exploited on a leasing system under State control, results seem satisfactory, at least in a financial way, the people of Minnesota having had to pay no direct taxes in 1910.

It is obvious, however, that the rapid changes which are being introduced into the economics of the State by the spread of commercialism must gradually introduce such imperfections into present truths as we cannot now foresee. Thus, as a result of the growth of private monopoly power, government is forced to extend its sphere of influence into realms of industrial and commercial activity, which were hitherto left entirely to private initiative. And it is further compelled, if inefficiency and stagnation are to be averted, to provide artificial means of thrift and encouragement, which old-time competition provided naturally.

One of the correctives of private monopoly evils, it was said, consists in extending government control and regulation over all trade, including all the chief commodities, staples, and necessaries of life. In the United States the volume of trade depends mainly on three factors, besides the attitude of the common carriers:—the extent of the country's production of food stuffs and raw textiles, the willingness of Europe to invest capital in American securities, and the ability of the country to import the gold it needs for effecting its exchanges. Hence we expect to see government intervention in the States run chiefly along the lines of financial sanitation. In Germany financial conditions are as sound as they can be in a comparatively poor country. We have everything in the way of a central bank, regulation of the flow of circulation and supervision of industrial capitalization. If anything more it is the amount of production, distribution, and price of commodities which remains to be regulated by the central authority.

The above quoted "Kali law" is the first significant step in this direction. It is the firm utterance of the paternal State making it clear to private enterprise that Government is going to take charge, as receiver, of any business which is itself incapable of developing or finding forms of organization—be they syndicates, kartells, or trusts—which will satisfy both the social and the economic needs of the Empire. Being one of the few German measures which may serve as a model to American legislators, it will be interesting to learn more of its details. As was said, its purpose is to safeguard the special assets of the nations without resorting to the ultimate means of public ownership and operation. The law provides equal opportunity for all producers, big and small, and equal opportunities to all consumers, domestic and foreign. It assigns, through a supervising bureau, a certain annual quota to each mine, the amount depending upon the producing capacity and output of the mine in previous years. It levies a graduated tax, an internal revenue tax by nature, on excess deliveries, regardless of whether the goods are destined for home consumption or for export. It prevents dumping abroad by providing that part of the quantity of potash allotted to each mine must be reserved for domestic use, our domestic trade in potash being larger than all the foreign trade combined. Finally, it fixes the maximum price at which potash may be sold on the home market, allowing a fair profit to the mine owners and making provisions to the effect that the export price must not be lower than the inland price.

More interesting even that the operations of State partnership and control of industrial enterprises are the effects which it exercises on the general business of the country. Considering that the State is a producer, a legislator, and a consumer at the same time, it is obvious that Government possesses the power to regulate the flow of business, that it can prevent sudden shocks, averting or, at least, softening panics and making for stability and continuity of enterprise. Technically speaking, the State in Germany acts like the governor and flywheel of a mighty engine, cutting off and storing in its mass surplus power in periods of abundance and yielding it again to the machinery of business in times of relaxing activity and rising need.

Stability and continuity of business is a great blessing to the whole community, but especially is it a blessing for the less fortunate working classes of the land, who in times of adversity are the real sufferers. There is no better proof of the fundamental difference between our respective economic systems—the American regulating itself and the German being regulated by a beneficent government—

than a comparison of business fluctuations in certain intervals. The sharp ups and downs from boom periods to depressions in America are but mildly reflected in our mean economic curve. And while we do not know the sensations and gains of wild speculation, we are also spared the calamities and losses which impulsive action entails. Nor do I hesitate to say that there is a marked tendency among conservative statesmen in Germany to avert, by all means, that influx of American tendencies which would transplant the spirit of extravagance, waste and destruction from your "unlimited" to our "limited" opportunities. Germany simply can not afford to run things on the American plan. We can not afford to follow you either in prodigiousness or in prodigality. We could not afford even to be democratic, commercially, if politically we had any leaning in that direction, as long as the experiment is as expensive as it is in the United States.*

The State obviously can succeed in the fulfilment of the noblest of its duties—to be a protector of the poorer classes—only by preserving the German market, which is six times larger and more important than the foreign market, as far as possible from rapid fluctuations and panics, cutting excessive profits on the one hand and making for continuity of employment on the other. Even in the Union, according to a recent interpretation by Justice Holmes, "the State's power to prevent panics must be recognized." And the State can attain this aim, outside of public ownership, only by gaining control over the elements of business—capacity of production, organization of trade, and fixing of prices—in addition regulating wages and working conditions of laborers in such a manner that it will secure for them the best possible benefit of their toil without endangering the competitive strength of our national industries in the world's markets.

State partnership and control, besides steadying business, has the further great advantage that it strengthens the confidence of domestic and foreign investors in commercial enterprise. In these days when the ability to borrow money means everything to a country, enabling industries to continue with the work of construction and reconstruction, keeping mills busy and laborers at work, anything that will restore and maintain the people's confidence in man's work is good. Of course, here again righteousness and ability, and trustworthiness of the country's administration, are the Alpha and Omega of national credit. Where these faculties are lacking or undermined it is useless to advocate the German system.

---

* Compare: Henry Jones Ford, professor of politics in Princeton: "The Cost of Our National Government," a study in political pathology. The Columbia University Press, 1910.

Nor does it seem wise in my own country to extend the productivity of the State too far into the activities of a higher order, for instance, to industries where creative ability, elasticity, and agility are decisive factors. These the big body of the State can hardly possess in the same degree as private enterprise, because in public operation the personal element of gain is lacking, and because the sensation of money making can never be wholly replaced by the more exalted feeling of public responsibility, even where ethical values of compensation are so highly appraised as they are in Germany. But it is certain also that, the larger the enterprises of private monopoly grow, the more incrusted, the more fossilized and unwieldly, the more like public enterprises do they become, so that ultimately, the only chance of competition left is competition between State and private activity. For the chances of competition between private industries of the different countries we have seen grow fainter in the measure wherewith enterprise is internationalized, and capitalists find it more profitable to prey jointly upon the world's markets under some form of agreement, than to cut their profits by wasteful competition. International concentration is a natural result of private monopoly, so that the only alternative of stagnation in the different countries is for the State to create thrift and encouragement artificially. But while this scheme of State competition works well in the production of raw materials and, perhaps, half-finished goods, of which the State can produce a reasonable amount, at reasonable cost, it does not do so for the higher grades of goods; because, though the State is a model employer, it is not yet a model manufacturer, nor can be until administrations avail themselves more liberally than heretofore of technical talent.

In this emergency the State comes to the rescue in its function not as a producer, but as a consumer and educator. Its services in this direction are so numerous that at this place it is possible to dwell on only one or two of them in the briefest possible manner. Taking, for example, the Prussian State railways. It is known that they are the greatest consumers of coal and iron and steel and kindred products. Being elevated above party politics, above fashions, and above judicial whimsies, their annual demand is fairly constant, and orders are distributed to the various industries according to a predetermined plan, thus guaranteeing a certain steadiness of industrial activity the year round. In times of depression Government can, of course, help to adjust conditions by pushing construction. Having eliminated discrimination to shippers, cut out political corruption, lobbying and favoritism, avoided over-capitalization and gambling with railway stock, stopped the waste of divergent effort and overconstruction on speculative values, the nationalization of railways has effected all the economies which the United States are striving to attain through the application of efficiency systems to the various private roads. Being subject to criticism in the Parliament, having to make public account of their activity, the State railways are a mighty weapon in the hands of the people, making for unity of transportation facilities, safety and promptitude of service, stability of enterprise and diffusion of profits. That the State railways are a good, though not stable, source of revenue to the Government (yielding in Prussia 59 per cent of the gross income, of which the fiscal mines contribute 9 per cent), and that, last not least, they are a powerful instrument of strategic usefulness in the hands of our military authorities, goes without saying. But what is even more important for engineers is the fact that, as the biggest of all consumers, our railways are in a position to force industries, by specified orders, to supply not merely what is commercially most profitable to private monopoly, but what is technically best suited for public safety, for industrial service, and for national progress.

Likewise, considering the army and navy—the pillars of our national defense—in the light not of engines of destruction (as the apostles of peace love to do), but of consumers of the products of our home industries, it is easy for the engineer to see what educating and quickening influence these agencies exercise on national productivity. In this leveling age of ours when almost everything makes for mediocrity of endeavor, it is wise to regard the stern art of warfare not merely as a means of demolition, but as an instrument of progress and character building—to regard not only the deplorable loss of life and capital which it involves, but to reflect also upon the beneficent effects which it exercises as a tonic to national industries.

There is a natural identity of aims between the modern State, whose duty it is to protect the country against foreign invasion, and the creative class of men, whose very existence rests on the provision of adequate means of defense. Thus army and navy are both the defenders and stimulators of technical excellence, being of all consumers, private and public, the only ones which act free from mercenary motives, subordinating the price to the quality of goods, asking not for the cheapest but for the best materials money can buy. Where would our Krupps, our Loewes, our Siemens, where would our high-grade industries have their being, if it were not for the need of tempering the country's armour?

Capitalism, in spite of all the social agonies it creates, is a necessary stepping stone for the uplift of humanity; and so is war the great nation builder. He is, indeed, an evil friend of his people, a poor *connoisseur* of history and human nature, who would replace the sturdy virtue of manliness, the elemental love of country, the cultivation of national ideals, by hypocrisy, internationalism and the vulgar scramble for money. Material rewards never have inspired and never will inspire men to noble deeds, to self-denial and self-sacrifice which are essential to the progress of nations.

Nor does progress often travel along the path of least resistance, whereas character and genius always develop their highest faculties when they are forced to overcome obstacles. Thus American engineers have become masters in the art of over-bridging distance, which is far, and overcoming labor, which is scarce, while German engineers under the stress of necessity excel all others in the art of utilizing scant resources, cutting out waste, reducing losses by efficient organization, and creating novel values of exchange from worthless *débris*. Wherefore we have no premises on which to envy our richer brethren for their imminent plenty, but are satisfied and resolved to make the best of our perennial want, taking consolation from the words of Francis Bacon: "Prosperity was the blessing of the Old Testament; adversity is the blessing of the New. Which carrieth the greater benedictions?"

THE CEMENT AND IRON INDUSTRIES; A COMPARATIVE STUDY.

By Edwin C. Eckel.

The following paper is based, in part, on an address delivered by the writer before the Association of American Portland Cement Manufacturers at their meeting in New York City in December, 1910. That address will be printed elsewhere in its original form. For the present paper, material modifications have been made both in scope and in presentation. The more important of these changes are in the elimination of certain sections which were of interest to cement manufacturers only; in the extension of the comparative method to other phases of the cement and iron industries than those originally published; and in the presentation of additional matter relative to the iron industry itself. The following paper, therefore, covers a much broader field than did the original address; and is, it is hoped, a more balanced presentation of the subject so far as general technical and industrial interests are concerned.

Since the delivery of the original address, the United States Geological Survey has published a preliminary estimate of the Portland cement production for 1910, while final statistics of the iron industry of that year have been published by the American Iron & Steel Association. In the present article these newer figures have been substituted, wherever possible, for less complete data which were used in the address. The two statements of the case will therefore differ somewhat in their figures, but the general conclusions reached are not altered.

SOME years ago, in the course of an official report on the American cement industry, I took occasion to draw comparisons, along certain lines, between the cement and the iron industries. It was pointed out that the two industries agreed in being engaged in the manufacture of products which were bulky and cheap, and that in each case transportation entered heavily into the final cost of the product to the consumer. The present time seems appropriate for a re-examination of these questions, and for an extension of the comparative study then begun. Both industries are emerging from a period of industrial strain, during which the question of profit was not as important as that of mere existence, and both are looking forward to a period of better conditions. No one who was interested in the two industries can have failed to recognize the fact that the period of business depression through which both passed affected them in very unequal manner. It is of interest to attempt to determine why this difference exists, and whether there is any reason to hope that in future the cement industry may acquire the same degree of resisting power as the iron industry.

In working out along this line a comparison of the two industries, the factors to be considered fall naturally into three groups.

In the first place it is necessary to compare the general industrial importance of the two industries, as measured by the tonnages and value of pig-iron and cement annually produced, the capacity of existing plants, and the capital actually employed in the two lines of manufacture. After this it will be possible to compare the two industries with respect to tonnages handled, and to the costs and profits which are yielded on a tonnage basis. Finally, it is profitable to consider the geographic localization which has taken place in both the iron and cement industries and the effects of this localization.

I. THE RELATIVE INDUSTRIAL IMPORTANCE OF THE IRON AND CEMENT INDUSTRIES.

ANNUAL OUTPUT.—While the importance of the American iron industry is a matter of popular knowledge, the rapid growth and present standing of our Portland-cement industry is rarely comprehended, even by those directly interested in it. This fact was brought home most forcibly during the preparation of the present paper, when a direct tonnage comparison between the two industries was instituted for the first time. Some half-dozen years ago, when I first compared the annual output of the American iron and cement industries, it was necessary to plot the pig-iron output in tons of 2,240 pounds and the Portland cement output in barrels of 380 pounds, in order to bring the two curves together on the same diagram. The necessity for doing this has passed away with the recent rapid growth of the production of cement, and it is now possible to make our comparisons directly in long tons.

Comparison of the two sets of figures year by year is interesting, but it is hardly necessary to go into so much detail in the present discussion. The following table will suffice to summarize the main features of the past three decades, giving the output of pig-iron and cement during every fifth year from 1880 to 1910 inclusive:

TABLE I.—COMPARATIVE GROWTH OF IRON AND CEMENT INDUSTRIES.

Year.	Pig-iron, long tons.	Portland cement, long tons.	Percentage, cement to iron.
1880	7,749,233	7,000	0.1
1885	7,415,469	25,000	0.3
1890	9,202,703	56,000	0.6
1895	9,446,308	165,000	1.7
1900	13,789,242	1,414,000	10.3
1905	22,992,380	5,874,500	24.3
1910	27,298,545	12,500,000	47.0

The relative growth of the two industries, as shown in the last column of the above table, is the point of greatest interest. It will be remembered that the thirty years covered in the table was a period in which the American iron industry was practically reconstructed in order to meet the requirements of modern large-scale production; and that in this period it had impetus given to its growth by the opening of the most productive of the Lake ore-ranges. In spite of these facts, however, the growth of the iron industry did not begin to compare with that of the newer manufacture. These relations are brought out still more strikingly on the diagram, Figure 1. On reference to this it will be seen that although the American iron industry has shown a rather remarkable rate of growth, particularly since 1896, this rate has been more than surpassed by that of the cement industry.

In this connection it is also of interest to note that as yet, even during years of severe business depression, the cement output has never shown a decrease. In the iron industry, on the other hand, such temporary reversals of trend are common, having been particularly noticeable in 1908 and, to a somewhat less extent, in 1904 and 1894. Taking account only of the present condition of the two industries, we can say that the tonnage of Portland cement produced during the past year was almost exactly half that of the pig-iron produced. It is practically certain that during 1911 the cement tonnage will improve on this comparison.

Value of Annual Product.—When the comparison is extended so as to take account of value of product, however, the disparity between the two industries is considerably increased. Exact figures as to value during 1910 are not of course obtainable, but it will probably not be far from the truth to assume that the pig-iron output averaged in value about $15 per ton, and that the Portland cement produced was sold at an average price of $5 per ton. The total value of the pig-iron produced during 1910 was therefore in the neighborhood of $400,000,000, while the cement output aggregated about $60,000,000 in value. It will be seen later that this great disparity in value is out of all proportion to the capital required in the respective industries

Productive Capacity.—There is, of course, always a considerable gap between the actual output in any given year and the total nominal capacity in that year. This is true in both the iron and cement industries. Even in a year when every plant is apparently pushed to the utmost, we find that relining furnaces and kilns, strikes, accidents, etc., make a heavy deduction from the nominal available capacity. Even after allowing for this fact, however, it is to be noted that in 1910 there was more than a normal disparity between

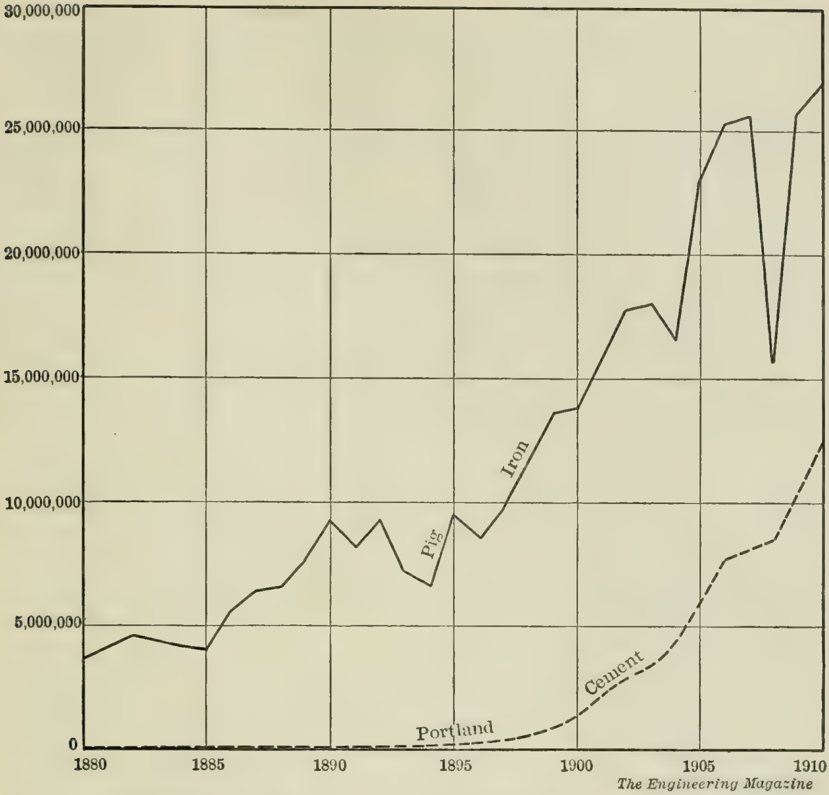


FIG. I. COMPARISON, IN LONG TONS, OF AMERICAN IRON AND CEMENT PRODUCTION.

the actual production and the productive capacity. This was more apparent in the cement than in the iron business, but it occurred in both industries.

It is probably entirely safe to assume that at present the blast furnaces of the United States have an actual available capacity of 35,000,000 tons of pig-iron per annum, and that this tonnage could actually be produced in 1911, for example, if business conditions warranted operations on this scale. As compared with this furnace capacity, the Portland-cement plants of the country will have in 1911 an actual capacity of close to 17,500,000 tons. The cement capacity, like the cement production, is about half that of the iron capacity and production.

Capital Employed.—The capital actually employed in each of the industries is about the same on a tonnage basis, being closely equivalent to ten dollars of capital per ton of actual annual output. This includes real estate, plant, machinery and working capital. The figures given have, of course, no definite relation to the amount for which the two industries are "capitalized," which is a very different matter. On the basis of capital actually employed, the pig-iron interests of the United States would represent an actual investment of somewhat over $300,000,000, while the cement industry would represent a little under $150,000,000. When this statement as to capital used is compared with previous figures concerning the value of annual output, it will be seen that the rate of turn-over of capital is markedly different in the two industries, being approximately three times as fast in the iron industry as in the cement business. The effect of this difference on the relative rate of profit in the two industries is painfully obvious, and will be recurred to later.

Relative Standing of the Industries.—It is best to summarize the facts heretofore presented, before going on to another line of comparison between the iron and cement industries. In regard to three of the matters which have been considered—annual output, productive capacity, and capital employed—we find that the cement industry is just about half as important as the iron industry. When value of product is considered, however, iron becomes far more important; and this fact has an important influence on the respective profits of the two industries.

The growth of the Portland-cement industry has not ended, and its present relative importance is rarely understood. Its increase in size and in commercial influence bring with them certain consequences which might well be borne in mind at the present moment. We can no longer feel that the cement industry is small and unimportant, and that its condition is purely a matter of private or local interest. On the contrary, it must be realized that the soundness of the cement industry has now become a matter of interest not only to cement manufacturers, but to commercial and financial interests generally. In capital employed it probably ranks third only to iron and coal among the American mineral industries. It certainly far outranks, in this respect, all the gold-mining industry of the United States and Alaska. Even the copper industry falls into lower place, for Finlay has recently estimated that the value of all the copper-mining and smelting plants of the United States is only $110,000,000. From the banking point of view, therefore, we are dealing with one of the world's three great extractive industries.

II. Comparison of Tonnages, Costs, and Prices.

Passing from general comparisons of the relative importance of the iron and cement industries, it is of interest to compare the raw materials handled, the costs of raw materials and labor, and the prices obtained. This can be done most satisfactorily when the comparisons are made on a tonnage basis; and in the present section all the data are therefore referred to the same basis—the long ton of salable product.

TONNAGES HANDLED.—The following table contains data on the quantity of the various raw materials required in the manufacture of one ton of iron or of cement. In the case of pig-iron two sets of figures are given. One of these is based on practice in Alabama, where low-grade ores and rather poor fuels are in use. The other set of iron figures is representative of Pennsylvania practice, where the coke is of high grade, and the ores, whether Lake or foreign, are excellent. The figures for cement manufacture are fairly representative of a plant running on a mixture of limestone and shale. In the case of the cement figures the amount stated for coal includes both kiln and power coal.

TABLE 2.—COMPARISON OF TONNAGES HANDLED IN IRON AND CEMENT INDUSTRIES.

	Alabama pig iron.	Pennsylvania pig iron.	Portland cement.
	2.32 tons ore	1.63 tons ore	1.18 tons limestone
	0.57 tons flux	0.50 tons flux	0.39 tons shale
	1.55 tons coke	1.07 tons coke	0.53 tons coal
Total tons raw materials used......	4.44 tons	3.20 tons	2.10 tons
Total products made.....	1.00 ton pig iron	1.00 ton pig iron	1.00 ton cement
	1.73 tons slag	0.97 tons slag	

Inspection of the above table will show that the amount of raw material necessarily handled in the course of making a ton of salable product is considerably larger in the manufacture of pig-iron than in the manufacture of Portland cement. Even in the Pennsylvania region, where ores and fuels are of the best, somewhat over three tons of raw material go to the making of one ton of pig-iron; while in Alabama raw materials of lower grade necessitate the handling of four and a half tons to the ton of pig. In the Portland-cement industry, on the other hand, a little over two tons of raw material suffice to make a ton of cement. Of course, this great disparity between the tonnages handled in the two industries would disappear if the slag produced in the course of iron manufacture could be considered salable product; but even the most profitable utilization of slag leaves it a very unimportant source of revenue to the furnace.

RAW MATERIAL AND LABOR COSTS.—The preceding comparisons become more interesting and important when the element of cost is considered in connection with that of mere tonnage. Taking the quantities presented in Table 2, Table 3 has been prepared by the use of actual costs per ton for each of the raw materials, and the item of labor per ton of product has been added.

TABLE 3.—COMPARISON OF RAW-MATERIAL AND LABOR COSTS PER TON OF PRODUCT.

Alabama pig-iron.		Pennsylvania pig-iron.		Portland cement.	
Iron ore	$1.90	Iron ore	$5.17	Limestone	$0.39
Flux stone	0.28	Flux stone	0.34	Shale	0.09
Coke	3.65	Coke	2.63	Coal	1.19
Total raw mat'ls	$5.83		$8.14		$1.67
Labor costs	1.15		1.18		0.58
Raw material and labor	$6.98		$9.32		$2.25

It will be understood, of course, that in making up the preceding table only the three most important raw materials, and the bare labor cost, have been considered. Minor raw materials—gypsum, scrap, etc.—have been omitted, as have been repairs, waste, superintendence and all overhead expenses. The figures given for the iron industry represent actual costs during an entire year. It is probable that during 1906 and 1907, when labor was inefficient and supplies dear, iron costs easily exceeded those quoted by 10 to 15 per cent. As to the cement costs quoted, any efficient and well-located plant can match them.

RELATION OF COSTS TO PRICE AND CAPITAL.—Up to this point in the comparison, the great disadvantage under which the Portland-cement industry labors, as compared to the iron trade, has not been so apparent as to require comment; but with the next step in the discussion it becomes obvious enough. It arises primarily from the fact that, of the two industries, the manufacture of cement requires the investment of a disproportionate amount of capital. The effect of this factor on financial results appears in the following table:

TABLE 4.—COSTS, PRICES AND CAPITAL.

	Alabama iron.	Pennsylvania iron.	Cement.
Material and labor per ton	$6.98	$9.32	$2.25
Selling price per ton	11.20	14.98	4.50
Capital employed per ton	9.65	10.75	10.00
Margin between cost and price	4.22	5.66	2.25
Ratio, margin to capital	43.7 per cent	52.7 per cent	22.5 per cent

It will be seen that in the iron industry, during the year to which the data relate, the margin between the cost of raw materials and labor, and the selling price of the product, amounted to an average of 48 per cent on the capital employed. This margin had to cover

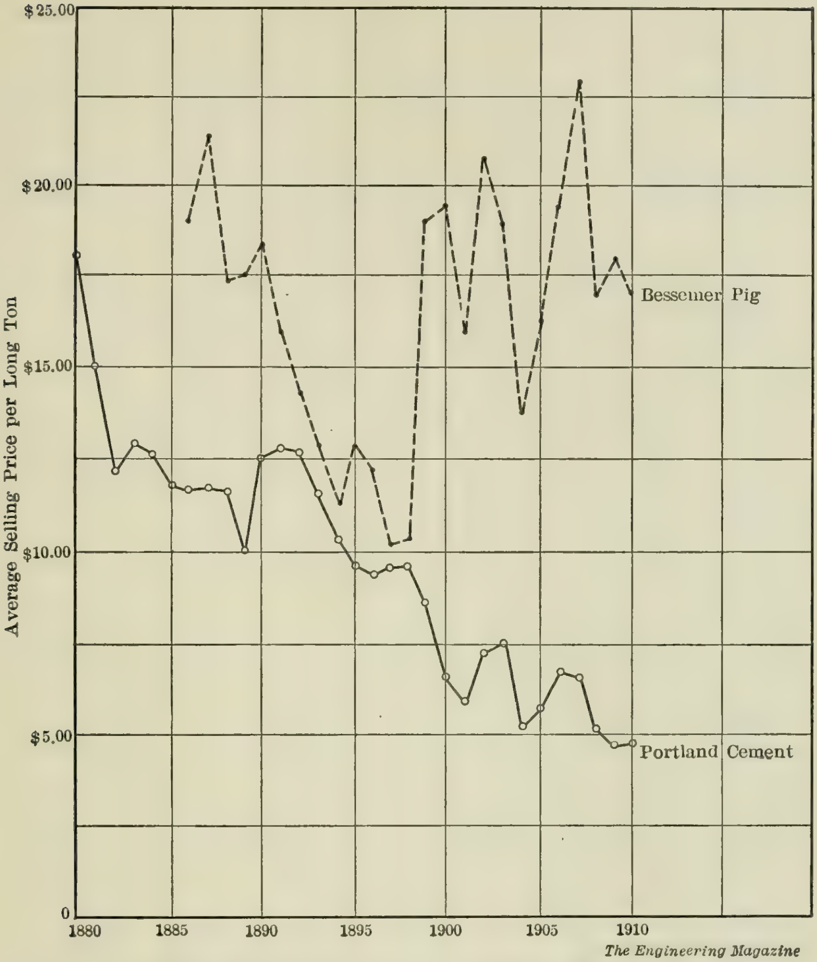


FIG. 2. PRICES OF PIG IRON AND CEMENT 1880-1910.

all the other items of costs, as well as depreciation, fixed charges and profits. In the cement industry the corresponding margin was only 22½ per cent, and it can readily be understood that under such conditions very little of it remained for profits after subtracting the other mill and overhead costs and charges.

THE TENDENCY OF PRICES.—An interesting difference in the price-history of the two industries is well brought out in the accompanying diagram—Figure 2—on which the average prices of cement and pig-iron have been plotted. The curves cover the period 1880-1910, so that the temporary price-fluctuations due to general business conditions can be separated from broader movements due to changes within the trades themselves.

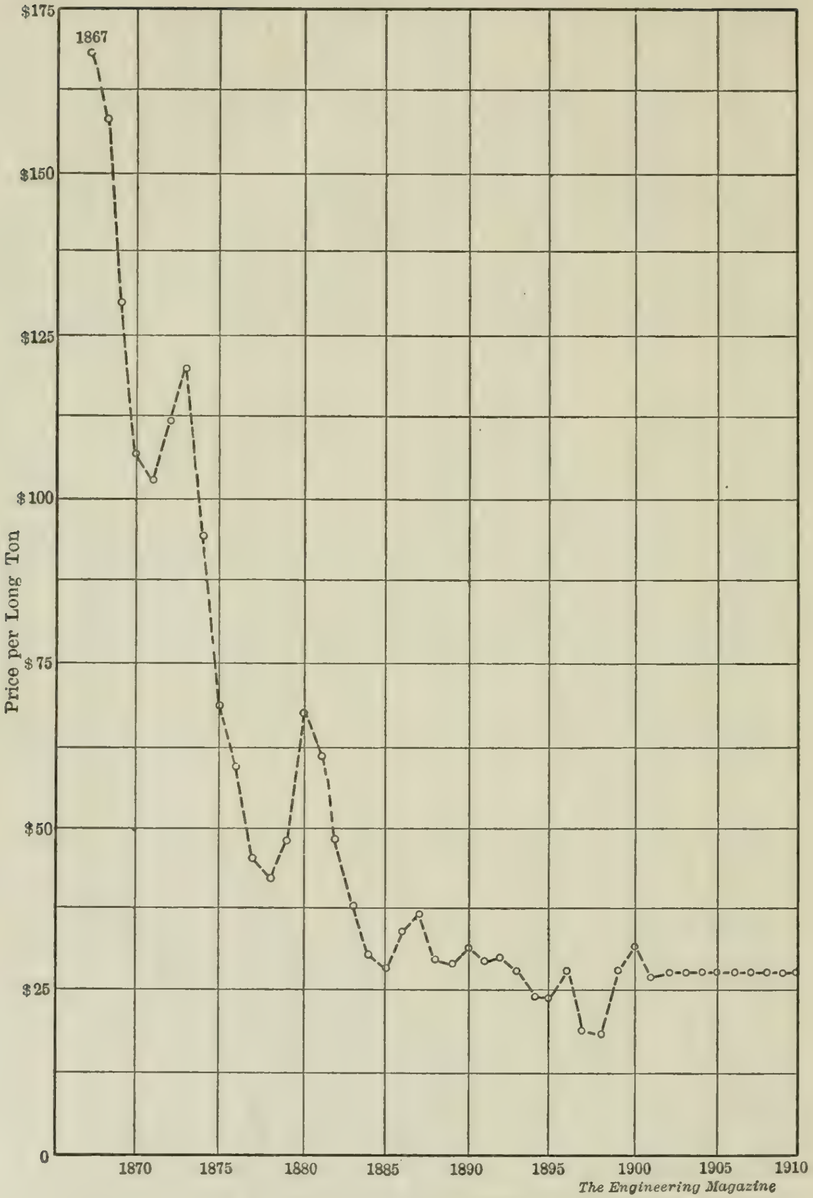


FIG. 3. STEEL RAIL PRICES, 1867 TO 1910.

On examining this diagram it will be seen that during the early history of the American Portland-cement industry there were several long periods when cement sold for about as much per ton as Bessemer pig. This seems almost incredible, in view of the present relation between the prices of the two products, for in the past ten years pig-iron has been steadily worth from three to four times as much per ton as Portland cement.

The marked divergence between the prices of iron and cement began in 1898, when cement prices failed to follow iron prices upward during the boom then commencing in general business. On the contrary, cement prices fell markedly and almost continuously until the present day. In all our industrial history there is nothing to compare with this downward movement except the spectacular decline in steel-rail prices during the four decades 1867-1897. In order to make this comparison available, Figure 3 has been prepared to give the rail prices for the period in question. It shows very strikingly the sharp decline from over $166 per ton in 1867 to $18 per ton in 1897, and also illustrates the early ineffectual attempts to steady prices around $28, and the later success of this effort.

THE TENDENCY OF COSTS.—Several years ago, in a little volume discussing the financial side of the Portland-cement industry, the writer took the ground that further marked reductions in the cost of cement manufacture could hardly be expected; and as yet there seems to be no reason to change position on this point. It would seem that a standard Portland-cement, manufactured in the usual way under normal conditions as to raw material, power and fuel, cannot well be produced at a much lower mill cost than the best of the existing plants have shown during the past three or four years. Local conditions may, of course, give exceptional low mill costs in exceptional localities —but it would be better if the fortunate plants which have exceptionally cheap power or fuel would regard their gain in this respect as an addition to their profits, and not as a reduction in their costs.

There is, of course, to be considered the possibility that the cement industry of the future may not be an independent industry, but rather an incidental attachment to the iron and alkali industries. Recent developments have by some been considered as pointing in this direction. The result on costs, in at least one of these cases, would be little short of revolutionary. But until this tendency is much more clearly defined, it will not be taken account of by the cement manufacturer.

As to the iron industry, the tendency of costs is distinctly upward, and it is highly improbable that even a prolonged business depression would enable any furnace to show such low costs as were attained during the depression of the nineties. The lowering grade of our iron ores, the steadily rising wage, and the higher range in coke prices, all tend toward higher costs for pig-iron.

III. LOCALIZATION AND CONSUMPTION IN THE IRON AND CEMENT INDUSTRIES.

In the present section attention will be directed to the manner in which the two industries are localized geographically, and also to the effect which this localization has had on the consumption of iron and cement in different areas.

PRESENT LOCALIZATION OF THE INDUSTRIES.—For convenience in this discussion the States have been divided into six groups. This grouping is, to some extest, rather arbitrary, but regard has been paid to trade conditions as much as possible. The six groups in question are termed "Northeast," "Middle West," "Southeast," "Southwest," "Rocky Mountain and Plains," and "Pacific Coast." The first group includes the States of New England, together with New York, New Jersey, and Pennsylvania. The Middle West, as the term is here used, includes the remaining States north of the Ohio together with the first tier of States on the west of the Mississippi. Southeast includes the States east of the Mississippi from Kentucky and Maryland southward. The Southwest, because of trade conditions, is made to include only the States of Kansas, Oklahoma, Louisiana, and Texas. With the Pacific Coast States in a separate class, the remaining western States are grouped in the Rocky Mountains and Plains.

With this explanation as to the manner in which the groups are made up, we are prepared to take up the present localization of the two industries. This has been done in the following table, in which the cement production of 1909 and the pig-iron production of 1907 are divided according to location:

TABLE 5. LOCALIZATION OF IRON AND CEMENT PRODUCTION.

Area.	Cement 1909.	Iron 1907.
Northeast	43.3 per cent	51.9 per cent
Middle	32.3 per cent	32.8 per cent
Southeast	4.4 per cent	13.4 per cent
Southwest	10.9 per cent	0.05 per cent
Rocky Mountain	2.7 per cent	1.8 per cent
Pacific	6.4 per cent	0.05 per cent

In explanation of the dates selected for the above comparison it may be noted that the pig-iron production for 1907 was used in preference to that of 1909 or 1910 because the output of 1907 seemed to show a more normal distribution of activity in the several regions than has been noticeable since that year ended.

In comparing the two industries, as in Table 5, it will be seen that in the Northeast, the Middle States, and the Rocky Mountain States the two industries are on a fairly comparable basis so far as percentage of the total output is concerned. They differ widely, however, in the Southeast, where the iron deposits of Alabama have caused the iron industry to give a relatively high production; in the Southwest where natural gas and favorable west-bound freight rates gave a corresponding advantage to the cement industry; and in the Pacific States where the cement industry has developed far beyond the iron industry.

LOCALIZATION OF CEMENT PRODUCTION.—Taking up the cement industry separately, the manner in which its output was distributed in 1900 and 1909 is shown in the following table:

TABLE 6. LOCALIZATION OF CEMENT PRODUCTION, 1900-1909.

Area.	Production 1900. Barrels.	Production 1909. Barrels.
Northeast	6,619,461	27,081,495
Middle West	1,469,407	20,163,186
Southeast	98,479	2,764,287
Southwest	106,000	6,818,516
Plains and Rocky Mountains	106,108	1,663,054
Pacific Coast	44,565	4,017,923
Total output	8,482,020	62,508,461

This comparison at the two dates in question shows the manner in which the cement industry has developed recently in certain regions where there was practically no development ten years ago. This development, as seems natural enough, was heaviest in the Middle West. The Southwest, owing to causes which have previously been referred to, also showed a very large increase in actual number of barrels produced and a still greater proportionate increase. The Pacific Coast also shows a heavy increase. The three remaining divisions, however, though of course they show a greater production in 1909 than in 1900, have fallen far behind the others in rate of increase.

PRODUCTION OF CEMENT PER CAPITA, 1900-1910.—It is only when the figures previously presented, as to production in various regions, are compared on a basis of the population of those districts, that we arrive at serious results in this study. This has been done in the following table, which shows the per capita production of cement in the various districts in the years 1900, 1909, and 1910. The production for 1900 is compared with the population for the same year. The production of 1909, the last for which we have detailed statistics available, is compared with the results of the recent Census. In taking up the estimated figures for 1910, the production for 1909 has been increased approximately 10 per cent throughout, while the comparison is with the same statistics of population:

TABLE 7. PORTLAND CEMENT PRODUCTION—POUNDS PER CAPITA, 1900-10.

Area.	1900.	1909.	1910.
Northeast	119	398	437
Middle West	19	296	325
Southeast	2	44	49
Southwest	7	358	394
Plains and Rocky Mountains	12	126	138
Pacific Coast	7	368	405
Average, United States	43	257	283

Examination of this table shows, to begin with, that the production of cement per capita in the entire United States is now in excess of the German cement production per capita. In view of the fact that Germany is confessedly a cement-exporting nation, this comparison is itself of considerable commercial interest. But the matter becomes more impressive when we examine the statistics for the different districts separately. Assuming that the production of 325 pounds per capita in the Middle West represents about what can be absorbed under normal conditions, we see that the Northeast, the Southwest, and the Pacific Coast have a per capita production considerably in excess of this; while the Plains States and the Southeast have a very small output per capita. As regards the Southwest the siuation is qualified when we remember that, by taking advantage of cheap fuel supply and low westbound freight rates, that district has been able to ship a disproportionate share of its output into the Plains and Rocky Mounain States. This fact accounts in part for the low per capita production in the Plains States.

The small production in the Southeast is due largely to the manner in which this district has for many years past been a dumping ground for the excess product of the Northeastern mills. A splendid natural market for cement has been largely destroyed in this process, and it would take a number of years of careful handling to bring the southern market back on a reasonable basis.

With regard to conditions in the Northeast, I think everyone will agree that the 437 pounds of cement produced per capita during 1910 is more than the market will stand under ordinary conditions, and that if the total capacity in this district were ever in operaion at once the result would be disastrous. There seem to be two possible ways out of the difficulty into which the Northeastern mills have plunged themselves, in order to avoid entire demoralization of this market during periods of dull or declining business.

DIRECT SELLING AND THE EXPORT TRADE.—The two methods of handling an over-built district, alluded to here, will appeal with different force to different men. The one way would be to adopt the policy of going actively after the small consumer, and making strenuous efforts to teach everybody to use cement for all possible purposes. This might involve in the end the partial or complete elimination of the middle-man, and the adoption of a policy of selling direct from warehouses to relatively small consumers. In the West more has already been done in this line than in the Eastern States.

The second method of saving the home market is to prepare for an active export trade. At present both the iron and cement industries export from 3 to 5 per cent of their total ouput.

Of course, in one sense, such a comparison of exports bears too hard upon the iron industry, for while the tonnage of cement exported above quoted comprises practically all of the cement and cement products shipped from this country, the bulk of our iron and steel exports are really in the more profitable forms of machinery, implements, etc.—and these finished products are not included in the figures above quoted.

If an attempt to secure a large export trade were directed with half the selling ability now used in the home market, it is certain that the Northeastern cement mills would be able to dispose of a very important portion of their product in West Indian and South American ports. It would not, of course, be a very profitable business of itself, but it would enable the manufacturers to maintain reasonable prices in the home market.

From a broad point of view it is of course true that no great profit to the country can be expected from an export trade in such relatively low-grade products as cement, pig-iron, and the comparatively unfinished forms of steel and iron. From the standpoint of maintenance, both of prices and of stable business conditions, however, an export trade may be advantageous to an industry even when it is normally unprofitable of itself. The critical writer in the popular magazines worries a great deal over the dumping of our products at low prices in foreign countries, but the same critic would have cause to worry a great deal more if he were responsible for the disposal of the surplus product which modern industry always causes to accumulate rapidly in time of local trade depression. However the law and the muck-raker may look upon it, our only solutions to the problem of over-production are dumping or most rigid restriction of output; and of the two solutions the latter does not demand consideration in the present discussion.

A SIMPLE SYSTEM FOR JOBBING AND REPAIR SHOPS.

By W. O. Horsnaill.

The system herein outlined is not offered as a new creation, but as an adaptation of proved methods and an application of sound principles to the conditions and circumstances of a small establishment. While it refers primarily to British conditions, the elements are fundamental and hold true anywhere.—The Editors.

MANY small engineering shops, dotted about the country, depend mainly upon jobbing and repair work for a living. The majority of these concerns are old-fashioned in every sense of the term, the principles, foremen, workmen, methods, and equipment being entirely out of date when compared with a modern machine shop. The standardisation and systematic manufacture of machinery—which has now become almost universal—tends to benefit these jobbing and repair shops, as such work cannot be profitably carried on in conjunction with the systematic production of standard machines or appliances. On the other hand, competition has seriously affected the prices obtainable of odd work, and estimates from several firms are now demanded where open orders were given out a few years ago. Furthermore, the correct estimation of such work demands good judgment, as figures for previous jobs of a similar character are seldom available in a usable form, hence prices are to some extent guessed at and often are hopelessly wide of the mark. This contention is amply supported by the estimates sent in for comparatively simple jobs, the highest being generally double the lowest, whilst the latter is not unfrequently below cost price when standing charges have been adequately allowed for. The effect of such estimating is naturally to lower prices for everyone concerned, and it is generally traceable to lack of system in connection with the accounts of the lowest tenderer.

Everyone admits the need for systematic methods up to a certain point, but great difference of opinion exists as to where "system develops into red tape." Similarly, certain general rules are readily acknowledged; it is only the means of carrying them out which are open to discussion.

These general rules may be set forth as follows:

1—The time spent and the material used upon each job must be correctly recorded.

2—The correct proportion of the indirect expenditure on rent, power, offices, etc., should be allowed for in the account.

3—The most efficient tools and equipment must be used.

4—The workmen must be caused to put forth their best efforts for the greatest possible proportion of their working hours.

5—The designs of the work undertaken must be: firstly, effective; secondly, economical as regards labour and material.

6—Tools and material must be so kept and checked as to be quickly available, whilst pilfering is rendered almost impossible.

Every proprietor of a small engineering works will endorse the above principles, but when the only effective means of carrying them out are propounded to him, he is apt to condemn them as a waste of time and paper. This attitude has been engendered partly by attempts in the past to apply to small concerns the methods necessary in a large undertaking, which for small shops are unnecessarily cumbersome.

"System" must be introduced into a small jobbing and repair shop with a great deal of care and tact, as unless the co-operation of the foreman and workmen be secured, success cannot be expected. In these small shops, one often finds middle-aged or old workmen who have been there for a great number of years and who consequently know their work well. Such men will strongly resent the introduction of new methods for checking time and giving instructions, and even the fear of dismissal will not always ensure their loyal co-operation in connection with what are deemed irksome features. The wholesale discharge of these old servants in favour of younger men who have been trained under modern systems would be a great injustice if any effective methods can be introduced which will avoid so drastic a measure. The foreman may also be a man of similar type who has never been called upon to perform his duties in a systematic manner. He probably depends upon a good memory for almost everything, aided perhaps, by a private note book. In addition to certain notes relating to orders in hand, these note books often contain a great deal of special information in connection with the work, the whole having been compiled in the firm's time. Such being the case, a foreman's note book might reasonably be deemed the property of the principal, yet a demand that it be given up when full, or even that it be inspected, would be strongly opposed.

So long as the business is conducted by the man who started it and who presumably is conversant with the work, no difficulties arise from this system; but when the principal dies or retires, his son, or an outsider who takes over the concern, finds himself dependent upon the foreman for any special knowledge connected with the work or the customer's requirements. These conditions will hardly be regarded as satisfactory by the most bitter opponent of systematic methods. By all means keep old and tried servants as long as possible. They understand the work and therefore should be able to handle it quickly, but no one wants to be *dependent* upon them.

It cannot be denied that very good results are often achieved in many small jobbing and repair shops by a hard-working foreman with a retentive memory, but even greater efficiency should follow the introduction of systematic records and instructions without the drawback alluded to above. Even one man working alone cannot depend entirely upon his memory, or if he does, his charges are likely to be erratic. Such a man will have perhaps a dozen jobs in hand at once, unfinished work being often put aside in favour of an urgent repair. Under these conditions, unless the time and material are jotted down as the work proceeds, errors are certain to creep in. Then again, some allowance must be made for rent, upkeep of tools, lighting, fuel, stores, etc., and accounts must be kept in some simple form to enable a correct allowance to be made for these items as a percentage on the time or labour cost.

Neither can the one man working alone afford to ignore our general rules 3, 4 and 5. He must obviously have the best tools, and the latter as well as material must be so kept that they are available at once without wasting time looking for them. Where half a dozen to twenty workmen are employed, these features become of much greater importance, and the methods adopted will have a vast influence upon the results.

Whatever system be adopted for carrying out our general rules, some means of distinguishing the orders, apart from the customers' names, must be employed. Furthermore, it is not advisable to pass on the actual letters to the foreman, hence the particulars should be copied onto another sheet for this purpose. It is also useful to retain a copy of these instructions in the office as the originals may occasionally be lost or destroyed. This can be done by using a manifold book, with or without printed headings, according to the number dealt with. These manifold sheets should be numbered consecutively, thus forming the order numbers referred to later.

Each of the general rules will now be considered separately.

1—The Correct Recording of Time and Material for Each Job.

This is the most difficult problem we have to deal with in the type of shop and with the description of workmen under consideration. A usual plan is for each man to record his own time on a chalked board, these boards being collected once a day or even once a week, for entry into the time book. Anyone who has seen the old-fashioned workman making out one of these boards will require little further evidence of the disadvantages attached to this system, the waste of time being a sufficient condemnation alone. A description of the process is somewhat as follows: first, the old marks have to be obliterated by rubbing on fresh chalk, the latter being often borrowed of a mate in conjunction with a little chat; second, lines are ruled for columns and headings, entailing a further converse over the loan of a pencil; third, the order numbers are generally forgotten, application being made to a mate or perhaps the foreman, who may have to be looked for; fourth, the time being put down from memory is often grossly inaccurate; fifth, the results are indistinct, easily obliterated and cannot be kept as a permanent record, whilst they are difficult to enter quickly in the time book owing to their lack of symmetry. The whole process may take half an hour in extreme cases and apparently has no redeeming feature. If the system must be employed, the cost of printed cards with rulings and headings would be far more than counterbalanced by the saving in time, but we still have inaccuracy to contend with and this cannot be avoided so long as the men are allowed to make their own records. Then again, incorrect times are not infrequently recorded for the purpose of increasing a piece-work bonus or avoiding blame for slowness.

It may be argued that a smart foreman should be able to check such practices, but it must be remembered that jobbing and repair work involves a good deal of discussion between the customers and the principal, and between the latter and the foreman, much of whose attention is thus occupied. Naturally, as the jobs are given out by the foreman, he can check the times by noting them down, and this plan is the ony satisfactory one. Assuming the time to be recorded in this way, the time boards become superfluous and it is only a question of providing the most convenient alternative. This brings us to the now well-known "job card," which is headed for the order number, workman's name (or number), and a description of the job, columns being ruled below for entering the times of starting and completion. When a job is given out, a job card is handed to the workman with the time marked in, and upon completion the card is returned and the time again recorded by the foreman. The only drawback to this method is a lack of flexibility for dealing with breakdown or other urgent jobs. It is no uncommon occurrence for a workman to suspend work on one job in favour of urgent repairs. In such cases he must give up his job card for a new one, the old card being restored to him when the old job is resumed. Entries of the time when given out or given up must of course be made in each case. The old-fashioned foreman is apt to give trouble over this exchange of cards, and even with the utmost tact it may be necessary to replace him with a younger and more up-to-date man.

Although the system is a trifle rigid when applied to jobbing and repair work, it acts as a check upon the frequent changing of the workmen to new jobs before the old ones are completed, by giving extra trouble to the foreman. This is a good feature, as an interruption to a job always means a waste of time and should be avoided excepting in cases of extreme urgency.

The times may be stamped on the cards by a recording clock, which can also be used to check the mens' time in and out of the works. In fact, this plan is much the best as it saves any possibility of dispute. In any case, the figures should be marked on in ink. This method of taking the time on the various jobs must give correct results so long as the loyal co-operation of the foreman is secured, whilst the cards are subsequently available as a permanent record. Material can be entered on the backs of the job cards, headings and rulings being arranged for this purpose. Whether the foreman gives out material or not, he must certainly authorize it by entering it on the cards. In the ordinary course the jobs will be laid out ready for the men by the foreman, together with the necessary material. It need hardly be stated that these material entries must be made in ink and the cards should have a surface which will at once show any attempt at erasure.

2—The Correct Apportioning of Indirect Charges.

To obtain the total amount spent on these items during six or twelve months is a simple matter, as all expenses can be charged up to one order number reserved for this purpose. With only half a dozen men this plan should prove satisfactory, as the number of items will not be very large and they can easily be abstracted under different headings at the end of each financial period. If twenty workmen are employed, it may be more convenient to institute several standing-order numbers so as to obtain classified results without the labour of abstraction; in either case the principle is the same.

Having found the total amount spent in this way, it is necessary to decide how it should be charged up to the customers.

This question will be more easily understood if we consider it by means of a simple example. We will suppose therefore, that the cost of items which cannot directly be charged to customers during twelve months has totalled £500 and that the value of the work done comes to £1,200 during the same period. Of this £1,200 we will suppose £200 to be net profit, leaving £1,000 for labour, material and indirect charges. The latter is already fixed at £500, hence the balance of £500 has been spent on labour and material.

The simplest plan would be to add 100 per cent to the labour and material for indirect expenses, but this method is obviously incorrect as certain orders may consist almost entirely of material, and a customer who ordered a steam gauge, with a short length of piping involving perhaps half an hour's labour, would be charged somewhere about 45 per cent extra on the instrument, in addition to 20 per cent profit. From this extreme example it would appear that the indirect charge should be based upon the cost of labour, and this is the plan generally adopted in small concerns. We will suppose that £400 has been spent upon labour, leaving £100 for material, then our £500 for rent, power, office, etc., would appear as 120 per cent on the labour.

This method is not by any means accurate as it takes no account of the use of machine tools. A jobbing shop such as the one we are considering will certainly contain at least one lathe of considerable size, and this tool will occupy much floor space and demand considerable power, hence it should pay its share of these items. Then again, depreciation should be allowed for on its original cost, and a certain charge be made for upkeep, repairs, stores, etc. If these items are reckoned up, it will be found that the cost of running such a lathe may reach 2 shillings an hour, in addition to the man's time, yet under the percentage-on-labour method, a much lower rate will be charged. In a large undertaking where plenty of clerical assistance is available, this drawback is often provided for in the form of a machine rate or of different percentages for the various departments. These methods would be too complex for the small concerns under consideration in which simplicity is essential. At the same time, some allowance should be made for the use of machine tools, and the best way of doing this is to fix a machine rate for each tool, based upon the factors already indicated, and for the foreman to go through each job card and make the necessary additions. This operation is simple enough to a man who understands the work and the results are fairly accurate.

Of course, in computing the total indirect charges included in the percentage on labour, the items going to make up the machine rate must be deducted. Thus a proportion of the rent—according to the space occupied by machine tools—most of the power, together with an allowance for repairs, capital charges, etc., will be subtracted from the total before the percentage is decided upon. The number of hours worked by each machine per annum will considerably affect its rate and it will be necessary to settle this point. It is obvious that no machine can work during full working hours, as frequent stoppages to set up new work are inevitable. Moreover, in a jobbing shop, it is doubtful whether any machine tool will be kept nominally working all the time, and it is quite certain that drills or shapers will be used intermittently only, perhaps up to 25 per cent of the full working hours. The question must be settled in each case in view of local conditions, and even then may have to be modified when the total charged by machine rates is compared with the deductions from the indirect charges.

Another point which affects both the percentage on labour and the machine rates is the amount of work dealt with during the six or twelve months, upon which the figures are based. If orders are scarce, the indirect charges will be larger in proportion to the labour than when the shop is busy. But it would never do to base our percentage and machine rates on such conditions, as this would increase prices when business is slack and orders are wanted. It is important, therefore, to take an average period or to make due allowance for the amount of work handled.

3—The Need for Efficient Tools and Equipment.

When considering this rule, it must be remembered that a tool which will have a high efficiency in a large manufacturing concern may not be worth the outlay in a jobbing shop. Automatic and semi-automatic tools are seldom needed for repairs and odd work, neither is it necessary to keep a set of limit gauges; but lathes, drills, shapers, etc., should be good solid machines of their kind and kept in good order. Also hand tools require careful attention. It is a mistake to try and economise by using files, taps, etc., in bad condition, as the saving is more than counterbalanced by the cost of extra labour.

It is by no means certain that the use of high-speed steel can be justified for the work we are considering. This steel is very costly, and the machines, if old, are unlikely to be sufficiently rigid to allow of the full benefit being realised. Moreover, many of the men will not have had any experience with the new material. All these conditions are, however, changing in favour of high-speed steel, which is becoming cheaper, whilst old machines are being scrapped and the old-time workmen are falling out in favour of younger men. The question of using this steel is largely influenced by local conditions, but it is sufficiently promising to warrant a trial before coming to a decision.

Included under this heading is the source of power, the method of transmission, and the layout of the shop. The choice as regards power rests between town gas, oil, and electricity from a public supply main. Steam is quite out of the running for small powers and the cost of replacing a steam engine and boiler by a gas or oil engine may be recouped in twelve months by the reduced expenditure on fuel and attendance, whilst the space taken up by the boiler and coal store will be available for other purposes. Under average British conditions no great difference in cost will be found between gas, oil, and electricity, hence it seldom pays to turn out one of these in favour of another, unless extensions entail the provision of more power. Should it be necessary, however, to make a choice the relative costs can be based upon a consumption of gas of 20 to 24 feet per B.h.p. hour, against .75 pints of paraffin and roughly one unit of electricity. Other costs such as attendance, repairs, stores and capital charges will not differ to any great extent.

The time will assuredly come when every machine tool will be sold with an electric motor embodied in its construction. In the meantime, shafting is the best solution, at any rate where it already exists, but it is important to reduce friction by laying out the shafting to the best advantage. Undue friction may arise from faulty alignment, old-fashioned bearings, or unsuitable belt drives. The alignment should be tested once every twelve months, crossed belts should be eliminated where possible, and thin belts with easy running butt joints should be used. Old-fashioned plain bearings lubricated with grease cause a great deal of friction and they should be replaced by self-oiling or roller bearings. The latter are no doubt costly but they save oil, attendance, and power to such a degree that the expense is fully justified. One effect of saving power in a new plant is sometimes overlooked; this is the reduction allowable in the size of the engine or motor, thus involving lower capital charges. Then again, pulleys, belts, and the shafts themselves may all be reduced in size, the cost being still further lessened. These factors are so effective in a new undertaking that the extra cost of roller bearings is more than counterbalanced, hence the total outlay becomes actually lower.

The layout of a jobbing and repair shop has an important effect upon its efficiency. Light, heat in winter, and ventilation are now well understood factors affecting the output. No man will do his best in a dark, cold or stuffy shop and under modern competitive conditions any falling off in output is serious. Good flooring is essential and all authorities are now agreed that wood is preferable to any other surface. Brick or concrete is too hard, and where it has been adopted the workmen generally insist on having wood racks to stand on. The floor must be even, and with a surface which is easily kept clean. The machines should have space round them for laying out finished or prospective work, and the operators' positions must be well clear of gangways. A great deal of time may be wasted if a man working a machine has to move frequently for the purpose of letting others pass.

In a small jobbing shop, the distances are generally so small that the "handling" problem is not so serious as in a large concern, at the same time the arrangements should reduce the amount of carrying as much as possible.

4—The Keeping-up of the Workmen's Output.

The considerations bearing upon the effective carrying out of this rule may be classified under two headings: "Facilities" and "Remuneration."

"Facilities" include instructions and the provision of tools and material, also the general tidiness of the shop. The lamentable waste of time where facilities are not systematically arranged, will be best shown by an example. Supposing a turner to have just completed a job, the acquirement of another with tools and instructions will be carried out somewhat as follows:

	Time Wasted
Finding foreman and waiting while he finishes talking to some one else	10 minutes
Finding labourer to assist and getting material to lathe	10 minutes
Obtaining drawing or sketch	5 minutes
Applying to foreman for gauges	5 minutes
Grinding tools	10 minutes
Obtaining lubricant for tool	5 minutes
Finding foreman and discussing meaning of drawing which is insufficiently dimensioned	10 minutes
Total	55 minutes

This is no fancy picture, but describes the kind of procedure taking place every day in many small engineering works. Moreover, the times specified would more often be under than over the mark. Hence we shall be justified in assuming an hour wasted on one job. This loss of time through lack of system extends in an equal degree to the men engaged upon hand work; in fact, it goes right through the whole concern. If we assume only ten men to be employed, each wasting time on only one job a day at a similar rate, and with an average pay of 8 pence an hour, the sum total per annum for 300 days will be £100—a very big item in such a small concern.

But the trouble does not end at this point; we have inefficient tools to contend with, as each man will have his own ideas as to their form. If the best cutting and feeding speeds are to be realised, the tools must be correctly formed by a trained man. Then again, tools require dressing and hardening in the smithy, and if each workman is allowed to hand his tool direct to the smith, chats will be indulged in and further waste of time involved.

It is not possible to eliminate the waste of time entirely, but a few simple rules of procedure will save most of the minutes which are lost in the manner indicated above.

Each workman should be able to go straight ahead with the next job as soon as the last is finished; and to allow of this, the work must be laid out ready by the foreman, with the necessary tools, gauges and instructions. The latter should be written in the form of sketches, drawings, or notes, and in all cases a copy must be kept. Drawings—which are now generally on tracing paper or linen—can be blue-printed, whilst manifold sheets are used for notes or sketches. Necessary writing of instructions includes only dimensions and any important features. Many cases will arise in which verbal explanations by the foreman may be necessary together with instructions regarding the method of procedure.

Drawings will probably reach the foreman with the order forms already referred to, but he must look through them and make sure that they give all necessary particulars before passing them on to the workmen. A great deal of time may be wasted if a drawing fails to show some important dimensions, and possibly the job will have to be temporarily set aside, involving taking it out of a machine and resetting, owing to the delay in getting the necessary information through the post. In a small shop it will generally be safe to lay out the next job with the tools alongside each man, but of course he will not be given his job card until he has returned the previous one.

To eliminate waste of time between jobs, the foreman (or some one who can act as his deputy) must be handy at all times to note the time on the cards and to give out the new ones. This is a question of office arrangement. A clerk will be needed for bookkeeping, taking the men's time, etc., and if he can be accommodated in an office opening into the shop, he will be able to assist in this work.

In all cases one experienced man should be responsible for preparing all tools. It does not necessarily follow that the tool man will do nothing else; in a very small shop, he may do fitting work as well. He will also prepare any special gauges needed. There are many adjustable gauges now on the market which are very suitable for small concerns, but the adjustment must be made by an expert, and the tool man will be able to perform this duty. With the jobs, tools and instructions prepared beforehand in the manner indicated, there should be little excuse for delays either between jobs or whilst they are in progress. Furthermore, the foreman's time, although taken up by this work, will not be wasted by disputes over mistakes or discussions on how the work should be done.

5—The Efficiency of the Designs.

There are two or more ways of doing many of the jobs in connection with repairs and odd work, and it is exceedingly important to hit upon the *best* way, having due regard to effectiveness and economy. Very simple jobs, which can only be done in one way, can be passed on direct to a workman; but if there is any choice, some one with the requisite experience must decide on the best course and his decision should be written down on one of the manifold sheets already alluded to. This work may be done by the principal, the foreman, or a draughtsman, according to the conditions under which the shop is managed. In any case, it is unsafe to leave the decision in the hands of a workman. The latter may, however, be consulted; in fact, in all such matters two heads are better than one and an experienced workman can often give valuable advice. More complex jobs, requiring working drawings, will sometimes be received, and if there are many such, a permanent draughtsman may be needed.

It is exceedingly difficult to get a draughtsman who can do this class of work satisfactorily. If a really good man is obtained, his salary becomes a serious item, whilst a draughtsman without a wide experience will cost a lot of money by introducing expensive designs. The available tools must be carefully considered and the foreman should be freely consulted on the way the work is to be done and the material to be ordered. Then again, theoretical knowledge will often be required. If the principal be an experienced engineer with a sufficient knowledge of theory, he will be able to supervise a junior draughtsman and this arrangement is the best and cheapest. On the other hand should the principal's knowledge be insufficient, it may be necessary to engage an experienced draughtsman. In either case, the latter must have plenty of tact, otherwise friction will arise with the foreman and the designs will suffer from the lack of his advice.

In a small undertaking, if a draughtsman is employed, he should be capable of notifying the principal of any material required. He may indeed write out the orders ready for signing.

6—THE KEEPING OF TOOLS AND MATERIAL.

A tool man has already been alluded to, and the question arises as to whether he should take charge of all tools and give them out, or simply make and repair them, the tools being directly in charge of the foreman. The choice beween these methods depends mainly upon the number of men employed. For a small number the foreman should certainly have the tools under his direct control, but in a shop where fifteen to twenty men are engaged the foreman's time will be taken up with other duties, and the care of and giving out of tools should be relegated to the tool man, the latter being accommodated in an enclosure where he can attend to the demand for tools over a half door. No check system will be needed for so small a number of men, as a tool man with an average memory will remember who the more valuable tools have been served out to, whilst lathe tools, chisels, etc., need only be given out in return for old ones which require dressing.

A lock-up enclosure for the storage of valuable material is essential in the smallest jobbing shop, and this store will also be useful to the foreman for laying out small jobs waiting to be done, and also for their reception when completed. It is absolutely necessary that all materials taken out of store should be booked to either a customer's order or a standing order, and whoever looks after the store must be responsible for doing this. Then when stock is taken, the deliveries together with stock in hand at the beginning of a financial period should equal the withdrawals *plus* the material in store at the end of the time. An exact balance is never actually arrived at, as there is certain to be some wastage, but if any great discrepancy is disclosed, pilfering may be suspected and an investigation can be made.

In a very small concern, the foreman will serve out material from the store as he gives out the jobs. In a larger undertaking the clerk already alluded to can look after the stores in addition to his other duties.

Whatever material is kept in stock must be stored in separate bins so as to be quickly found, and care must be taken that the stock is not exhausted in any line for which there is a frequent demand. The want of a dozen washers for some otherwise completed job may lead to waste of time by the workmen engaged upon it, and to the annoyance of the customer owing to the delay whilst these washers are procured. In large engineering works complex systems are in vogue for avoiding any difficulty of this nature, but for small stores such as we are considering, the man who serves out the material should be capable of keeping up the stock without mechanical aids. It will, however, be advisable to mark each bin with the minimum stock below which - further quantity should be ordered. Iron and steel bars are best kept by the smith, who will deliver through stores, whether pieces of bar or forgings—never direct to a workman. This method will ensure that all material of this nature is weighed and charged up.

No scrap or rubbish of any sort should be allowed to lie about the shop. Iron or steel scrap must be removed to scrap heaps at frequent intervals, whilst metal scrap is returned to stores.

Odd appliances, such as straps and bolts used for machine work, should be kept in boxes alongside the machines and each workman should have a lock-up drawer or cupboard to accommodate his tools. No shelves should be allowed underneath the vise benches, as they are awkward to get at and are apt to become receptacles for scrap or rubbish.

Those accustomed to the order and cleanliness to be found in up-to-date works will perhaps be disposed to regard the above rules as superfluous, but a visit to one or two jobbing shops of the old-fashioned type will soon remove any such impression. I have seen small works of this nature where even the gangways were cluttered up with scrap and rubbish, whilst the proprietors were deploring the difficulty of making ends meet. In one such concern, valuable metal was lying about all over the place without any adequate check upon it, and there is no doubt that the owners were losing hundreds a year from pilfering alone, not to mention the waste of time entailed by such disorder. The British workman is fairly honest so long as temptation is not placed in his way, but experience proves that where valuable metal is not checked, it will certainly be stolen to a considerable extent.

Ths simple system will suffice for controlling a small jobbing and repair shop without by methods which have stood the test of practical experience. In fact, all the methods put forward are being extensively employed in large concerns in a more complex form. The storage of correspondence, drawings and other records have not been touched on, as the proceedure in large concerns is adaptable to these small undertakings with very slight modification, and modern practice in connection with such matters has been fully explained elsewhere.

Systematic methods are now indispensable in large undertakings, and they will certainly become equally necessary for small concerns as competition emphasises the vital importance of efficiency.

GENERAL VIEW OF THE GERMANIA SHIPYARDS (FIFTH GROUP).

THE KRUPP WORKS.

The brief data accompanying the following views are condensed from statistics obtained from the authorities of the Krupp establishments and supplied by C. Van Langendonck.

THE illustrations on the following pages might be regarded as an accompaniment to Dr. Junge's leading article in this issue, for they show objectively one of the characteristic institutions built up under German industrial policy—one in which the co-ordination of private and State interests is characteristically manifest.

The pictures are to a large extent left to tell their own story, but in further explanation it may be noted that the entire Krupp works comprises five separate groups employing nearly 60,000 workmen and 6,750 engineers and clerks, the total capitalization being about $43,-000,000, and the management being carried on by a board of ten directors.

The five groups are, first, the Essen Steel Works, with proving grounds at Meppen, Tanger-Hütte and Essen; this group includes also the Milhofener-Hütte, with its four blast furnaces, the Hermann-Hütte, with three blast furnaces, and the Sayner-Hütte, with coal and iron mines, etc.; second, the Friedrich-Alfred Iron Works in Rheinhausen; third, the Annen Steel Works; fourth, the Gruson Machine Works at Magdeburg-Buckau; and, fifth, the Germania Shipyards at Kiel.

The Essen Steel Works alone comprise some sixty-odd departments, covering an area of about 500 acres and housing 7,200 machine-tools, 17 roll trains, 187 hammers, 81 hydraulic presses, 397 steam boilers and 569 steam engines, more than 2,200 electric motors, and 900 cranes. The coal consumption of the entire establishment is 2½ million tons a year. The characteristic product is steel (Bessemer, open-hearth, crucible, and alloy steels, armor-plate and ordnance).

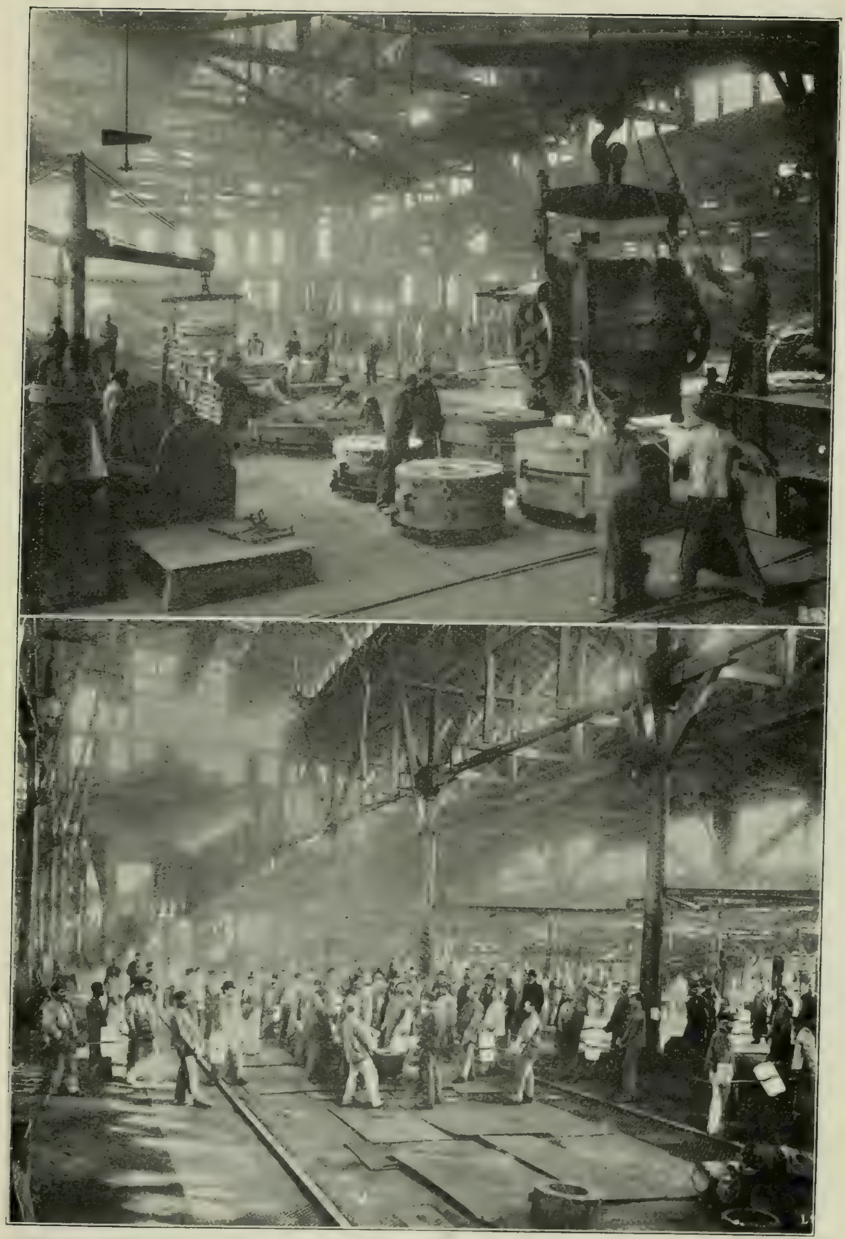
The Friedrich-Alfred Hütte includes 6 blast furnaces, with 15 blast-furnace-gas-operated blowing engines, and Martin and Thomas steel works.

The characteristic product of the Annen Works (third group) is open-hearth and crucible-steel castings and finished steel castings up to 25 tons.

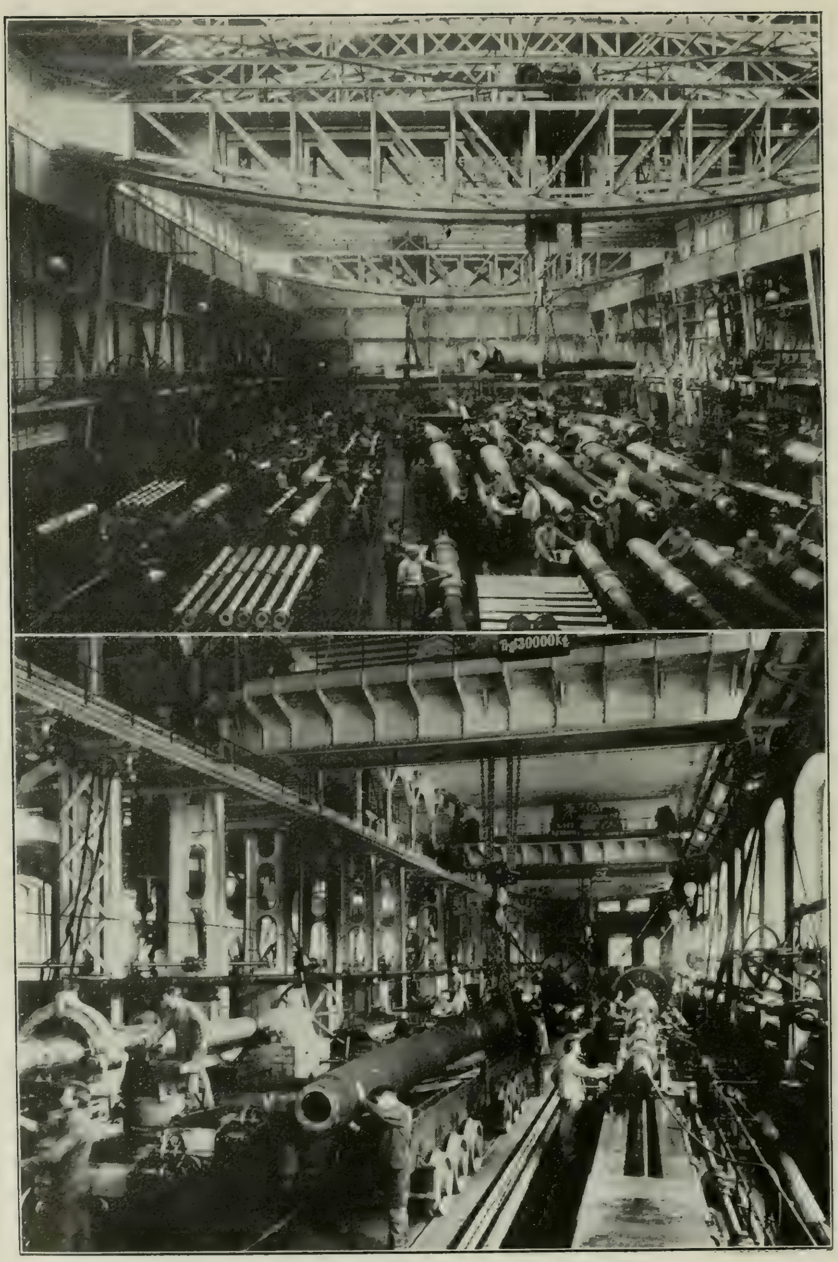
The Gruson Works at Magdeburg-Buckau are made up of more than 50 different shops, covering an area of 75 acres and housing 1,850 machine tools and nearly 500 cranes.

The Germania Shipyards cover an area of about 60 acres, with 8 building slips, of which the two largest can take vessels up to 725 feet long and 130 feet wide. Four of the slips are roofed. The forge shops cover nearly two acres; the main bay of the fitting shop is 475 feet by 78 feet, and the boiler shop is 400 feet by 212 feet.

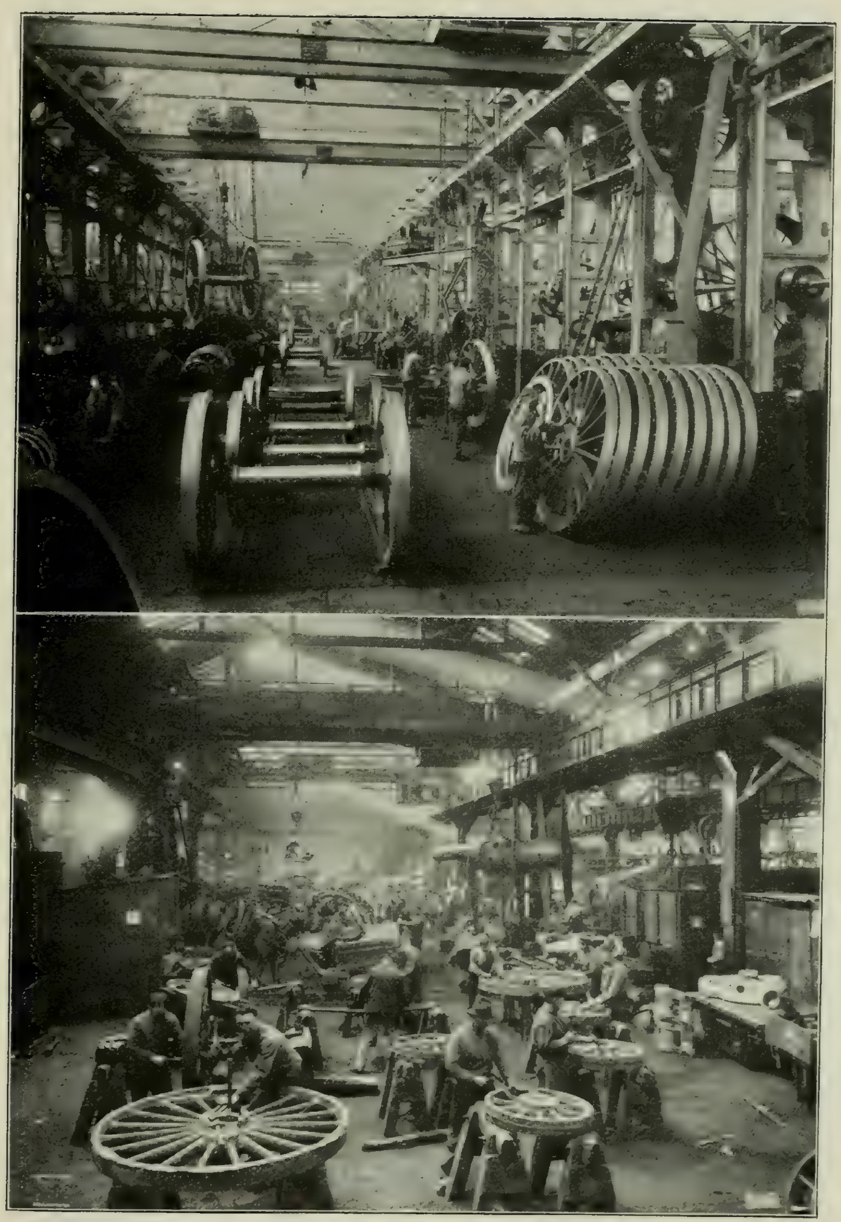
THE LITTLE HOUSE IN THE CENTER OF THE PICTURE IS THE BUILDING IN WHICH THE FIRST KRUPP BEGAN THE PRESENT BUSINESS.



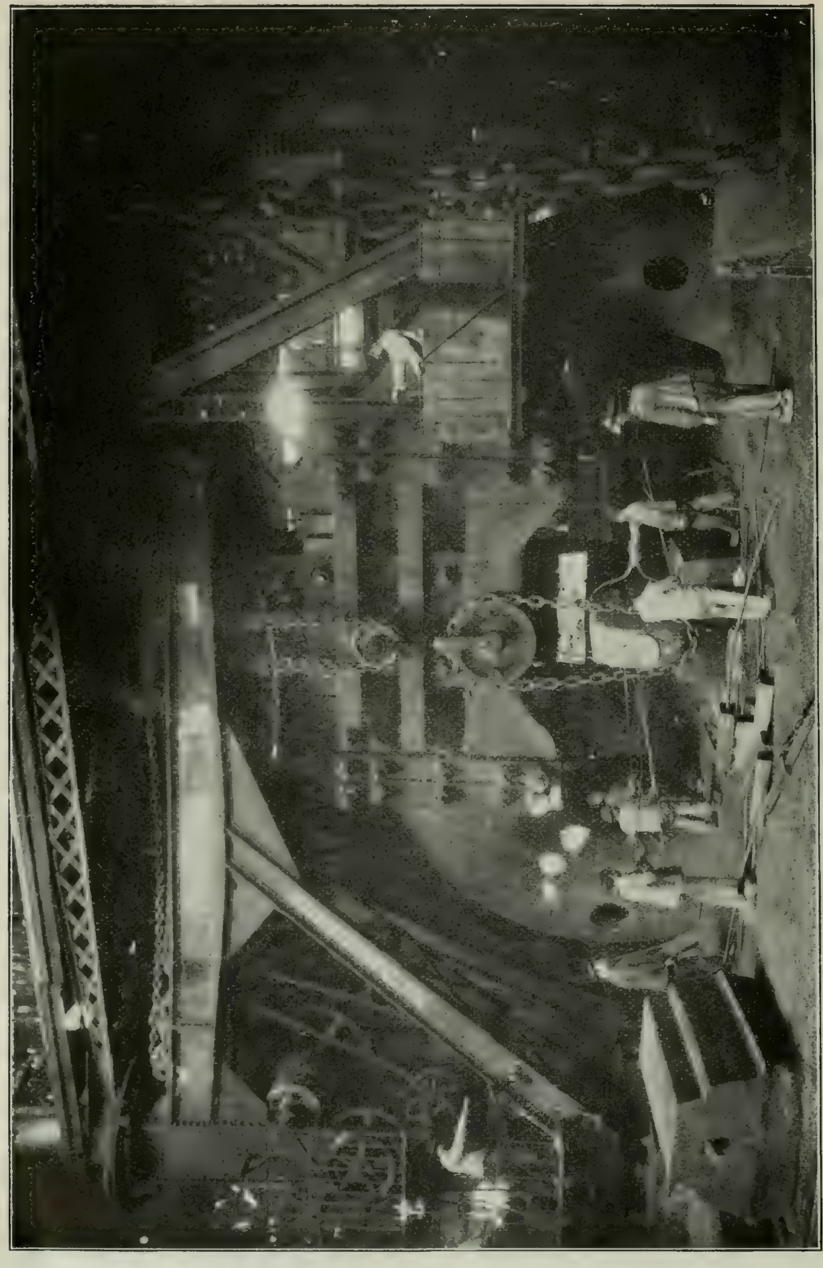
OPEN-HEARTH STEEL FOUNDRY NO. 3 (ABOVE) AND CRUCIBLE-STEEL FOUNDRY, ESSEN.
(FIRST GROUP.)



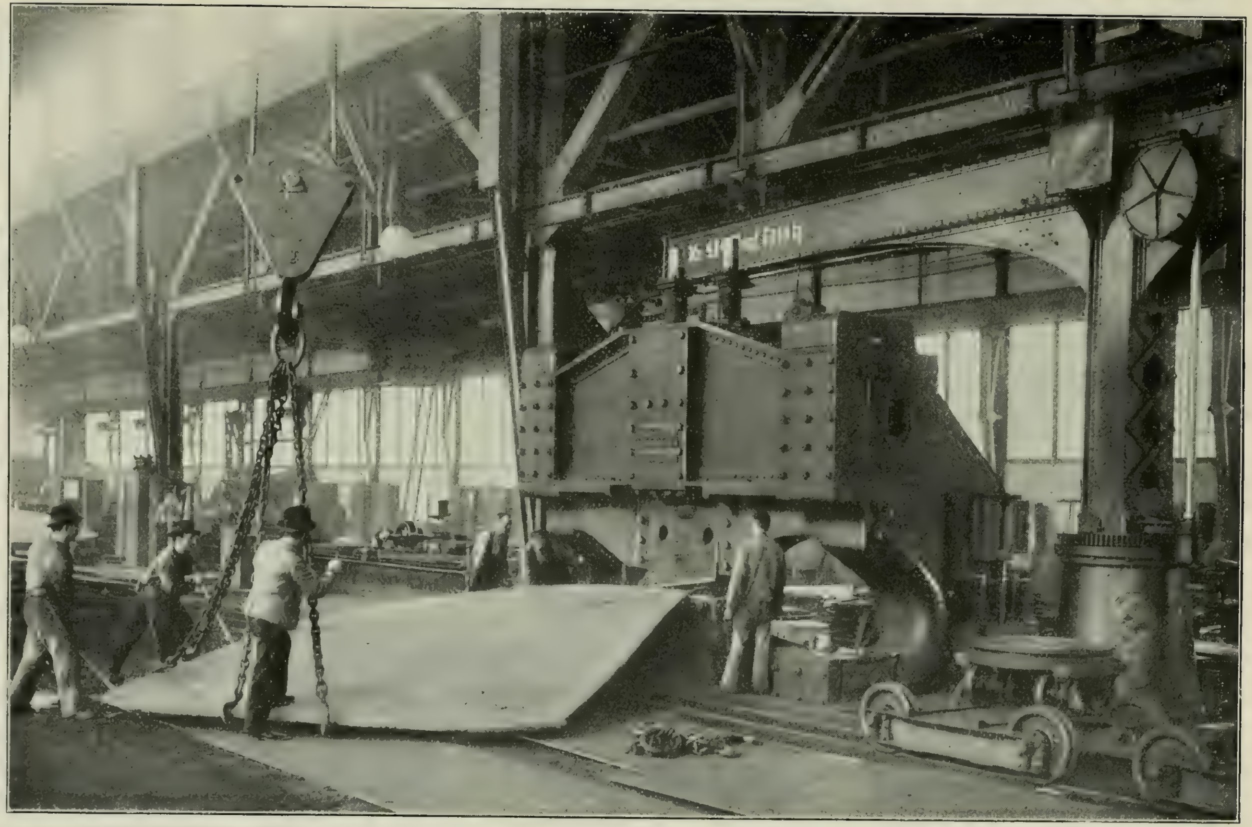
ORDNANCE SHOPS NO. 2 AND NO. 5, ESSEN.



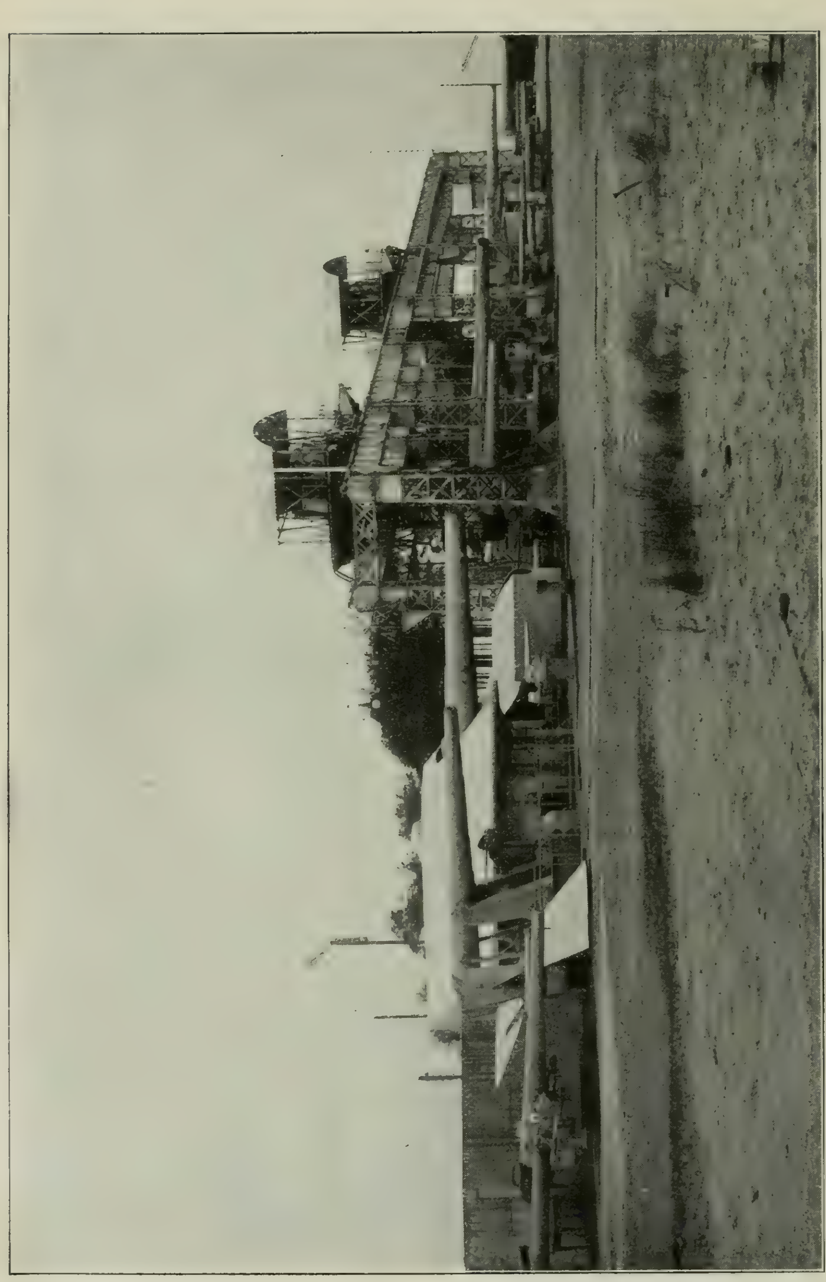
TURNING SHOP AND OPEN-HEARTH STEEL FOUNDRY, ESSEN. (FIRST GROUP.)



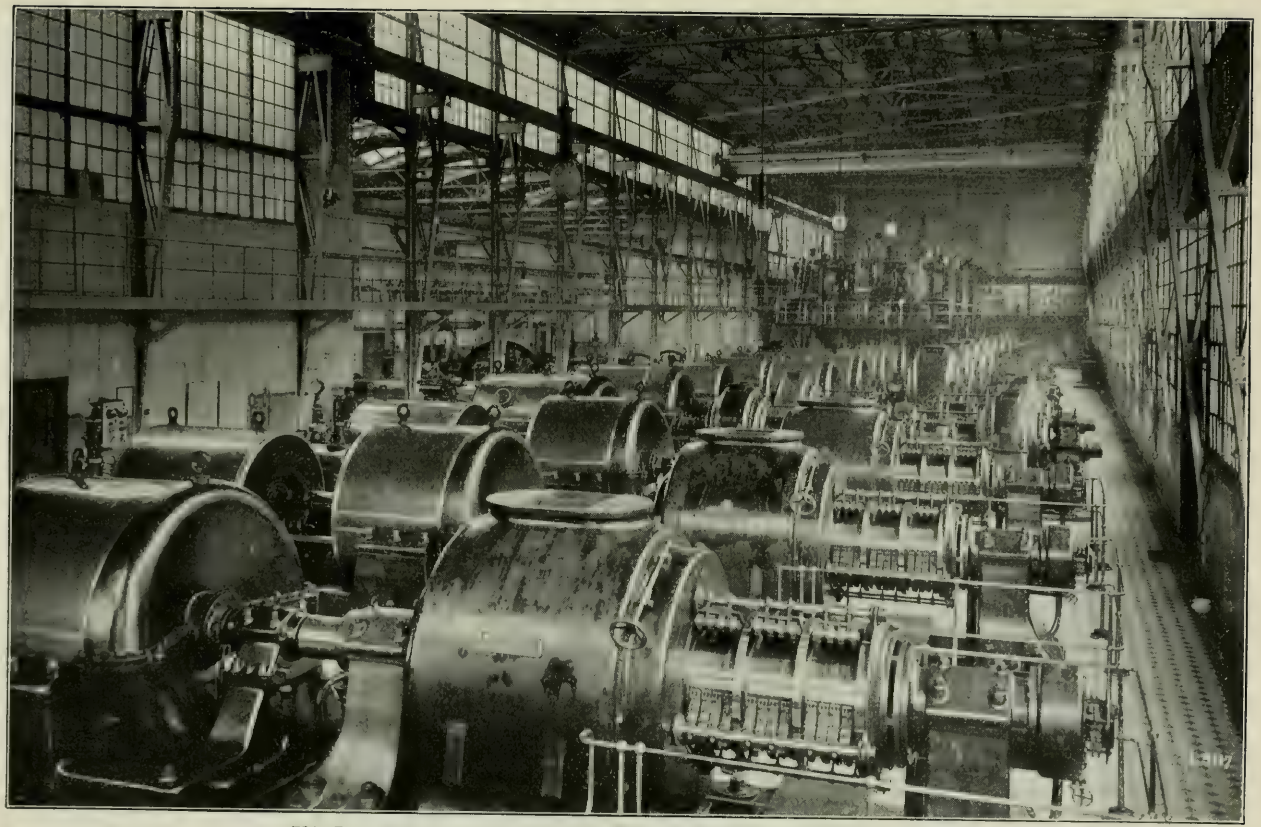
THE 50-TON HAMMER, "FRITZ," ESSEN STEEL WORKS.



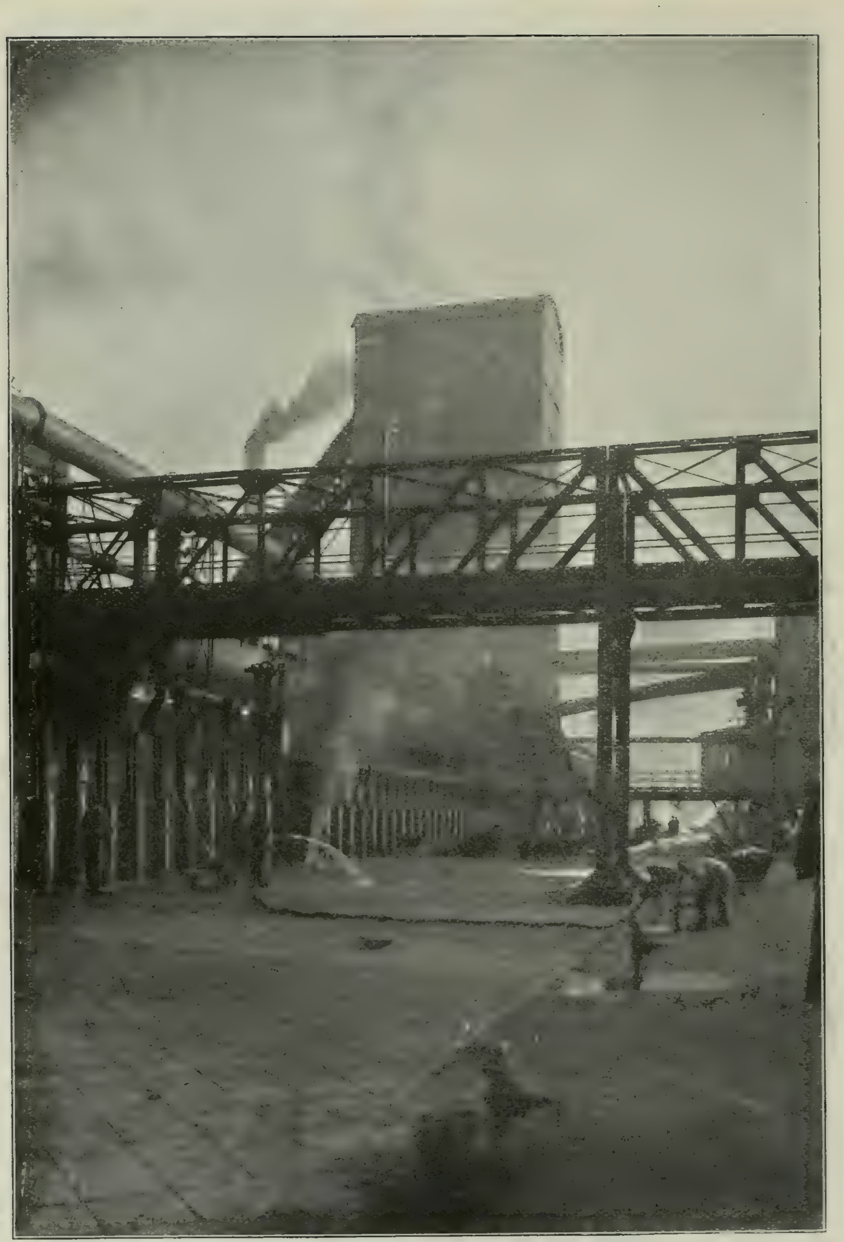
HYDRAULIC COLD SHEAR, ESSEN. PRESSURE, 600 ATMOSPHERES. CUTS PLATES 3 INCHES THICK. (FIRST GROUP.)



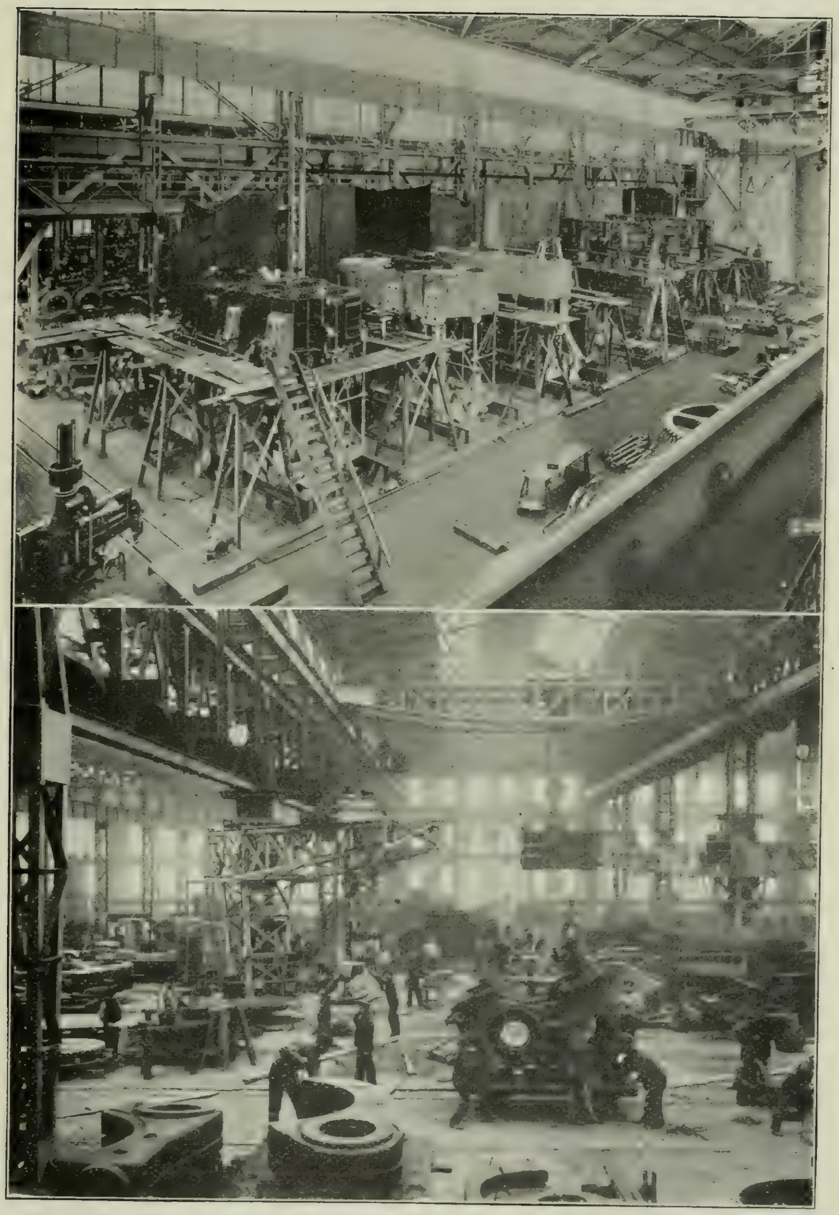
PROVING GROUND AT MEPPEN (FIRST GROUP).



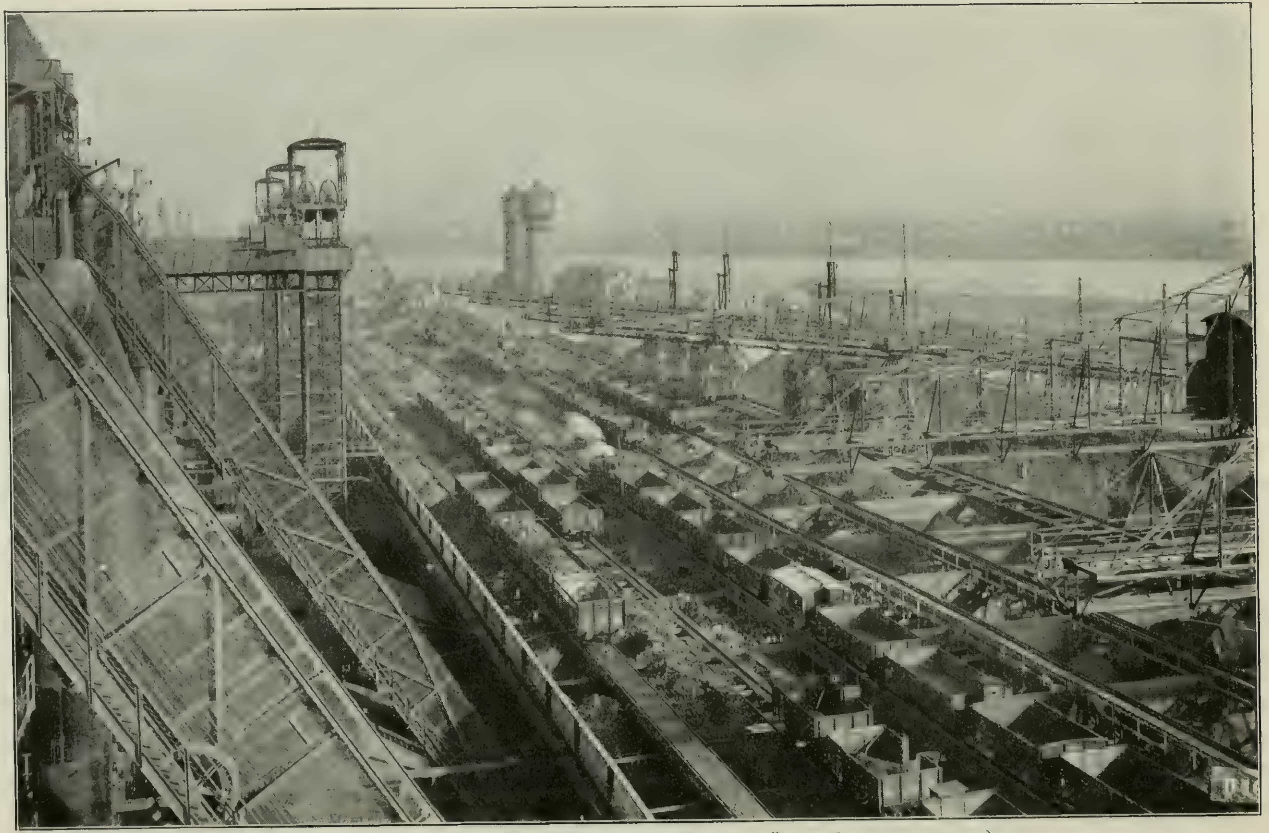
ELECTRIC POWER STATION NO. 2, ESSEN STEEL WORKS (FIRST GROUP).



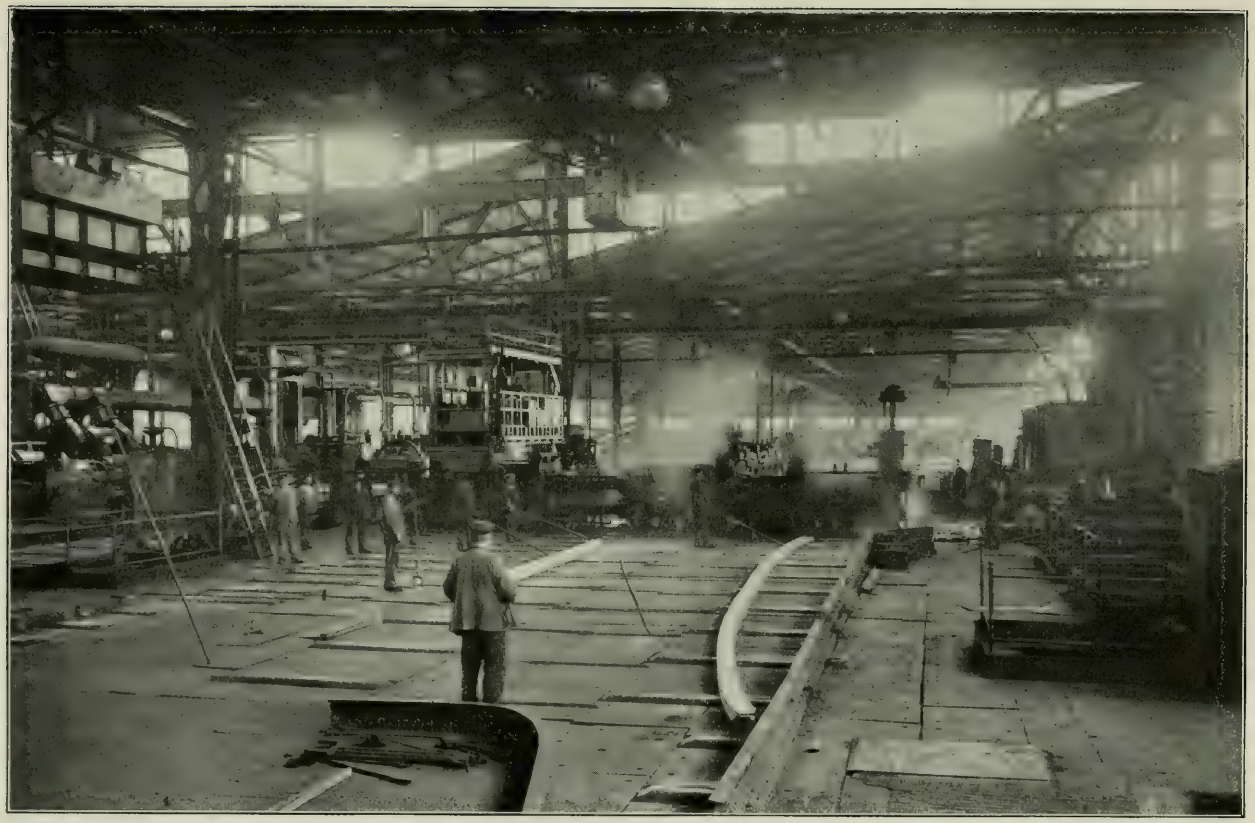
COKE-OVENS, VER SAELZER AND NEUACK COAL MINES (FIRST-GROUP).



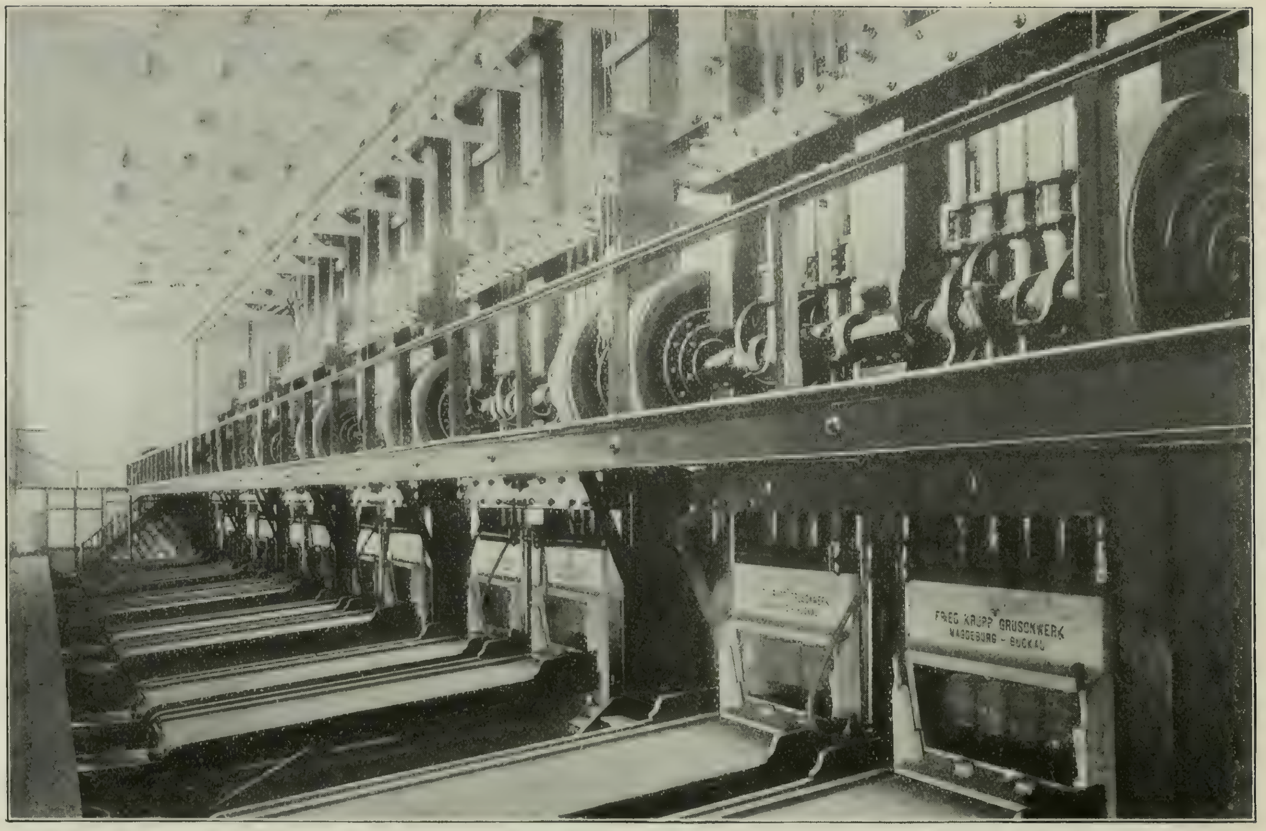
ERECTING SHOP AND IRON FOUNDRY, GERMANIA SHIP YARDS (FIFTH GROUP).
The engines assembled are for the warship Deutschland, the transport Borussia, and the coastguard vessel Assar-i-Tewfik.



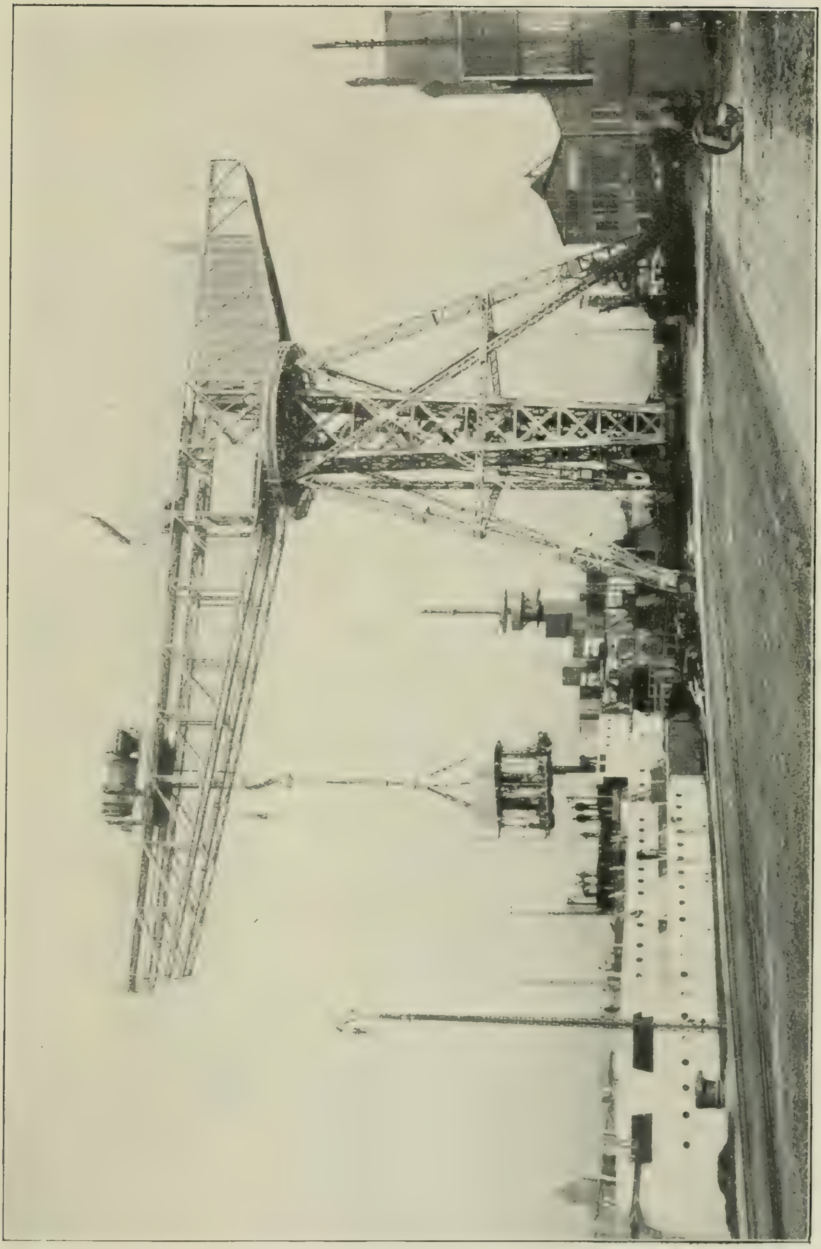
ORE-HANDLING MACHINERY, FRIEDRICH-ALFRED HÜTTE (SECOND GROUP).



TRIO OF 700-CENTIMETRE ROLLS, FRIEDRICH-ALFRED HÜTTE (SECOND GROUP).



STAMP BATTERY FOR THE GEORGE GOCH CO., ERECTED IN ONE OF THE BAYS OF THE GRUSON WORKS (FOURTH GROUP).



150-TON CRANE, GERMANIA SHIPYARDS (FIFTH GROUP).

THE PURCHASE OF COAL BY SPECIFICATIONS.

By Leo Loeb.

EVERY working day in the year the coal miners of the United States are preparing for public consumption 1,600,000 tons of coal, ranging in quality from the peats of Florida and the lignites of New Mexico to the anthracites of Pennsylvania and the semi-bituminous coals of West Virginia. The value of this product per annum is $1,360,000,000, as compared with $530,000,000 for pig iron, $164,800,000 for iron ore, $174,000,000 for copper, $90,440,000 for gold, and $37,300,000 for silver. Of this total production the steel industry is the largest consumer with 100,000,000 tons per annum; next the railroads which manage to burn usefully 70,000,000 tons while wasting 20,000,000 tons; followed by the Government, with a consumption of 2,000,000 tons; and finally the domestic users and unclassified industries. The total market value is a little lower than that of all the other mineral products of the United States.

In the majority of cases, and certainly by the largest number of individual consumers, less care is exercised in the purchase of this necessary commodity than in supplying any other need of industrial and domestic America.

Legally a contract is an agreement between two capable parties whereby one agrees to perform a service or furnish a definite article to the other for a consideration, yet the form of coal contract that is entered into by users, and the character of the product delivered to them, would indicate that they were far from capable parties.

The conservation movement has brought very forcibly to our attention the fact that the known supply of solid fuel is limited and a warning to observe care is clearly given; but in spite of that, such indefinite stipulations as "run of mine coal of good quality, reasonably free from dirt and slate" are only too common. What a different story when the article has greater bulk value, as iron ore, wood pulp, yarn, gunpowder, steel rails.

The object of any specification is to protect the consumer against inferior goods and to relieve him from continued anxiety over the cost of producing his output as affected by fluctuations in the quality

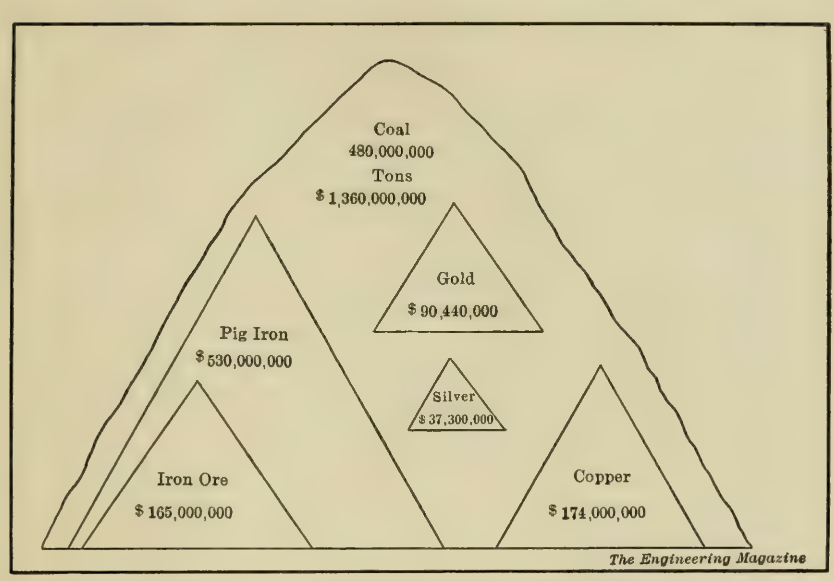
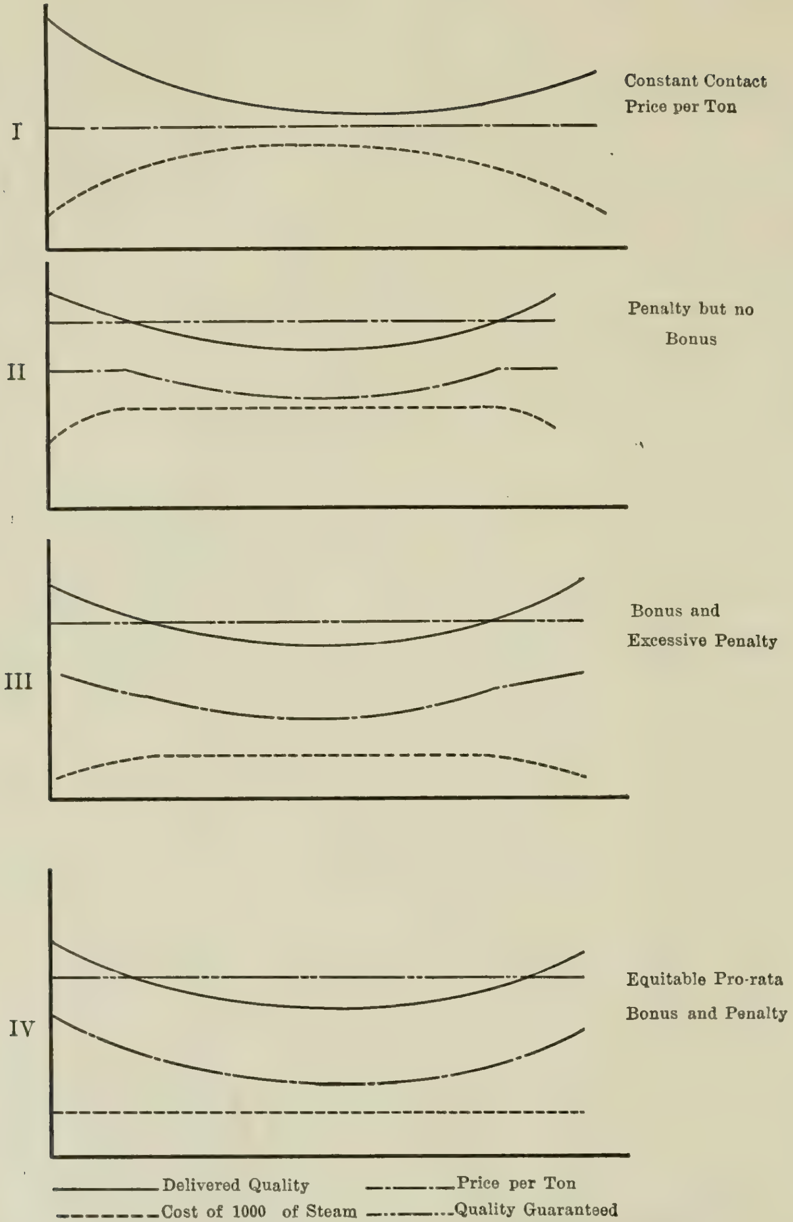


FIG. I. THE COAL PILE OF THE UNITED STATES.

of the raw materials. Of course, the exact form of specification—absolute uniform quality, or payment proportionate to quality—varies with the character of the material furnished under the contract. But if the consumer gets what he pays for, then the operator should get paid for the quality supplied.

The consumption of coal produces heat, and in general the manifestation of this is in the evaporation of water; so to insure the coal cost of a unit of output remaining constant, the manufacturer wants assurance that the cost of unit steam shall be constant. Figure 2 shows the variation in price per ton of coal and cost of steam production with quality under various forms of contracts.

In case I the price per ton is constant regardless of quality, and the cost of generating steam increases with decline of quality. In case II a penalty is exacted without a corresponding bonus. Then the price is adjusted in proportion to quality below standard, and the cost of generating steam is constant only so long as these adjustments are made. The dealer does not then benefit by supplying fuel above contract grade. In the third case the penalty and bonus are not in the proper proportion, and if the cost of generating steam is constant during portion of fulfilment of contract, it will not be so during the remainder. But if an entirely equitable basis of penalty and premium can be applied to all deliveries, the plant operation is not influenced by fluctuations in quality of coal delivered, and pay-



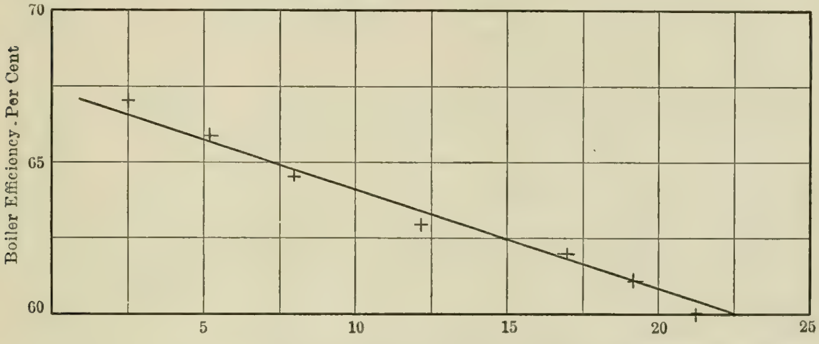
The Engineering Magazine

FIG. 2. VARIATION OF PRICE PER TON AND COST OF GENERATING 1,000 LB. OF STEAM WITH QUALITY OF COAL DELIVERED.

ment is always adjusted to quality. Such conditions are shown graphically in diagram IV.

Thus the problem in drafting a coal contract is to keep the cost of a unit of steam generated constant under all conditions of delivery of that coal. In this the proposition is no different from that in ore purchases, where payment is made on pure metal per ton of ore.

With this in view it is necessary to examine carefully the physical characteristics of coal with a view to determining the effect of these characteristics on the efficiency of steam generation. The so-called proximate analysis divides the constituents into groups which may be examined for the various effects.



The Engineering Magazine

FIG. 3. RELATION OF MOISTURE IN COAL TO BOILER EFFICIENCY.

(1) Moisture in the coal comes from three sources—inherent moisture from the mine, moisture absorbed in transit, and water poured on the coal by the seller. In any case it has no heat value; it is just so much dead weight, whatever may be its effect in caking the fine coal, preventing undue waste through the grates, minimizing the formation of clinker and reducing the nuisance of flying dust. In just so far as the water in coal affects the weight delivered, so it affects the storage capacity of the bins and the ease in drawing the supply from the bunkers. Again, the presence of water aids the slow oxidation of coal in storage and may in certain cases be the cause of spontaneous combustion. The effect on boiler efficiency is not as yet a settled thing. Although it requires just as much heat to separate a given quantity of water into its constituent elements of hydrogen and oxygen as are yielded when they again unite by combustion, recent tests confirm the belief that the presence of the hydrogen in contact with unburned carbon is an aid to complete combustion. In any case, moisture is much more economical through a water meter at 8 cents per thousand gallons than in a coal wagon at $3.50 per ton.

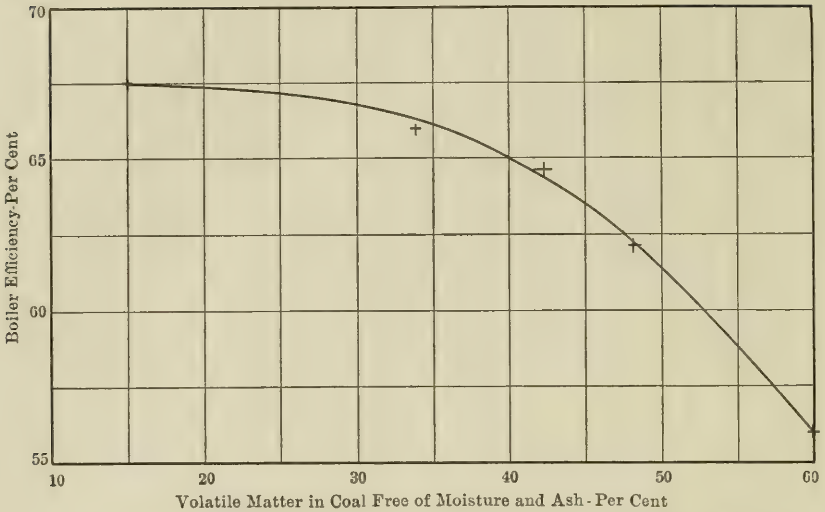


FIG. 4. RELATION OF VOLATILE MATTER IN "COMBUSTIBLE" TO BOILER EFFICIENCY.

(2) Volatile matter in coal is that portion, other than water vapor, which passes off as a gaseous product when coal is heated in a closed vessel. The total amount of such volatile matter is as low as 3 per cent in Pennsylvania anthracites, 20 per cent in the best eastern American semi-bituminous coals, and ranges upward for the western coals and lignites. But the remarkable part is the recently established fact that all coals contain from 1 per cent (Eastern coals) to 15 per cent (Western coals) of absolutely inert gases: carbon dioxide, nitrogen, ammonia—with no heat value.

The volatile matter evolved from the younger coals of the West includes a large proportion of carbon dioxide, carbon monoxide, and water, and a correspondingly small amount of hydrocarbons and tarry vapors. The older bituminous coals of the Appalachian region yield volatile matter containing large amounts of tarry vapors and hydrocarbons, difficult to burn completely without a considerable excess of air and a high temperature. Coal of the Western type, moreover, gives up its volatile matter more easily at high temperatures than coal of the Eastern type. The volatile matter produced at medium temperature is rich in higher hydrocarbons of the methane type, such as ethane and propane, which contain a larger proportion of carbon than is present in methane.*

This taken with the order of yield of volatile matter—first inert gases and illuminants, then hydrogen—gives the volatile matter as an index of the liability to produce smoke, danger of combustion in storage, and effect on boiler efficiency.

---

* "The Volatile Matter in Coals," Bulletin 1, U. S. Bureau of Mines, 1910.

(3) The fixed carbon in the coal requires no particular attention, since it will take care of itself by difference if the other constituents are properly balanced. The character of carbon, whether coking or non-coking, is important, but that is always a known characteristic of any coal field.

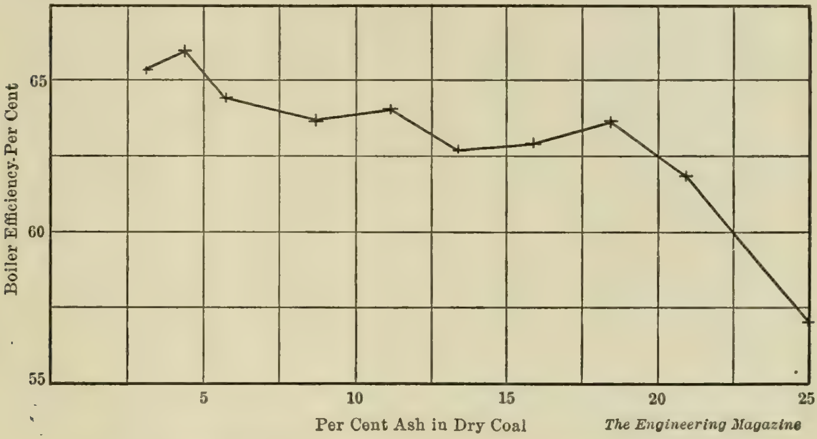


FIG. 5. RELATION OF ASH IN DRY COAL TO BOILER EFFICIENCY.

(4) Ash. The reasons for keeping the proportion of ash as low as possible are certainly obvious. It is so much inert matter when purchased and stored, it increases the labor of firing and cleaning the fires, it entails the extra cost of providing for its removal as refuse, it lowers the boiler rating and capacity, and it materially affects the boiler efficiency, as is shown on the accompanying diagram from a series of nearly 300 tests with different coals on a 250-horse-power Heine boiler. All the high-efficiency tests are on coals low in ash. The curve shows an average decrease of 1 per cent in boiler efficiency for each 1 per cent increase in ash. As regards amount of rated capacity obtained—a coal with 5 per cent ash shows 95 per cent rated capacity, while a 19 per cent ash shows only 84 per cent capacity.

(5) Sulphur occurs in coal in three forms: iron pyrites, free sulphur, and gypsum. The former is the more harmful, as it fuses together and forms a dense clinker which freezes to the grate bars, can be removed only with difficulty, and chokes off the draft. It is doubtful if the sulphur exerts any considerable corrosive effect on the boiler but the gases of combustion are frequently a nuisance.

(6) The sizing of the coal is important in regard to adapting any particular coal to the installation and to convenience in handling, but does not enter into the basis of payment. Tests show that small sizes in bituminous coals have the greatest efficiency, but that is un-

doubtedly due to the fact that the best American coals are very friable and break up in transit and in storage.

(7) Heating value in British thermal units per pound. This is without doubt the most important feature of any coal contract, because, although the boiler efficiency varies only slightly with heat content of the coal, the amount of steam generated per pound is directly proportional to the heating value of the coal. Likewise the boiler capacity is affected in proportion to the available heat in the coal. This heating value is influenced by moisture, ash, sulphur, and by the proportion of hydrogen to carbon.

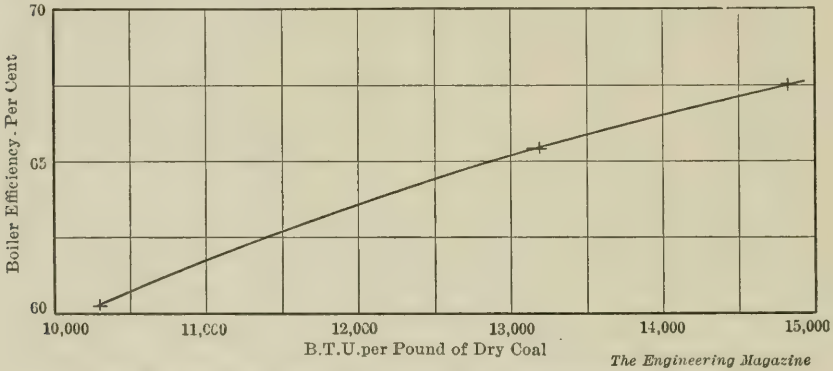


FIG. 6. RELATION OF B.T.U. IN DRY COAL TO BOILER EFFICIENCY.

Having considered the effects of the various constituents of the coal we are ready to undertake the drafting of a contract form. First, such general clauses as are required to make the contract valid in a court of record, as time and place of opening bids, evidence of good faith, quantities of fuel desired and place of delivery, weighing and the right to reject bids or terminate contract for cause.

Next should follow the clauses specifying who should do the sampling and analysis and what standards are to be used by them. It is better to ask for coal of approximate quality and allow the bidder to specify the exact quality he proposes to furnish, unless for unusual reasons a certain grade must be had. Then the bidder bears the responsibility of furnishing the particular coal guaranteed. The outside limits of ash, sulphur, and volatile matter, above which coal delivered on contract may be rejected, must be clearly specified and space provided for location of mine or group of mines from which the coal is to be supplied, so that the consumer may investigate and determine whether the coal offered is suitable for his needs. Finally, tables of deductions or premiums must be included.

As already mentioned, the moisture, ash, sulphur and inert volatile matter directly affect the heating value of the coal, so that the B. t. u. as delivered take entire account of such of these as effect capacity and not efficiency. It would be manifestly unfair to penalize for excess moisture and again for decreased heat value as received, for they are merely cause and effect.

The same is true for ash as far as it affects the quality of the coal, but it was pointed out that excess ash also causes extra labor of firing, expense of removal of refuse, and decreased efficiency of boiler, so that an extra penalty should be imposed for such excess and a corresponding bonus paid for deficiency.

A table is given for all ash guarantees from 5 per cent to 19 per cent, based on cost of disposal of refuse at 35 cents per cubic yard, coal at $3,00 per ton, hand firing, and decrease of boiler efficiency of 1 per cent for each 1 per cent ash, with an allowance of 1 per cent before deductions begin. The 1 per cent allowance is to provide for errors in sampling and slight latitude for deliveries.

TABLE OF PENALTIES FOR ASH IN EXCESS OF GUARANTEE.

Ash in dry coal guaranteed.	Deductions in cents per ton.					
	3½	7	10½	14	17½	21
5	6-7	7-8	8-9	9-10	10-11	11-12
6	7-8	8-9	9-10	10-11	11-12	12-13
7	8-9	9-10	10-11	11-12	12-13	13-14
8	9-10	10-11	11-12	12-13	13-14	14-15
9	10-11	11-12	12-13	13-14	14-15	15-16
10	11-12	12-13	13-14	14-15	15-16	16-17
11	12-13	13-14	14-15	15-16	16-17	17-18
12	13-14	14-15	15-16	16-17	17-18	18-19
13	14-15	15-16	16-17	17-18	18-19	19-20
14	15-16	16-17	17-18	18-19	19-20	20-21
15	16-17	17-18	18-19	19-20	20-21	21-22
16	17-18	18-19	19-20	20-21	21-22	22-23
17	18-19	19-20	20-21	21-22	22-23	23-24
18	19-20	20-21	21-22	22-23	23-24	24-25
19	20-21	21-22	22-23	23-24	24-25	25-26

Except in cases where the presence of a moderate amount of sulphur is harmful, no penalty is exacted, as it is difficult to arrive at a basis of such deductions, and experience has shown that the sulphur in coal from one district varies slightly. The same can be said of volatile content, where our knowledge is as yet too meagre to allow of an equitable correction. Actual contracts will be cited where both of these factors, however, are involved.

The method of arriving at the successful bidder in any case of bids submitted on a heat value proposal is to compute on each guarantee the net B. t. u. for 1 cent, or the cents per million B. t. u. The net B. t. u. for one cent is computed in the following manner: The product of the number of cents per ton correction for ash variation multiplied by the variation is added to all prices other than that of the coal of lowest ash content. This adjusts all prices to one level. Then the net B. t. u. for 1 cent is B. t. u. offered multiplied by pounds per ton divided by corrected price. As an example, take the case of four bids submitted on 1,000 tons run-of-mine coal for the Buffalo Post Office for the year 1909-1910.

Bidder.	B.t.u. as rec'd.	Ash in dry coal.	Price.	Price cor. for ash.	B.t.u. for 1 cent.	Cents per million B.t.u.
A.....	13,485	7.84 per cent	$2.90	$2.957	102,152	9.789
B.....	13,791	6.63 “	2.79	2.823	109,429	9.138
C.....	13,900	6.50 “	2.90	2.930	106,266	9.410
D.....	14,100	5.00 “	2.84	2.840	111,211	8.992

$$\frac{13{,}485 \times 2240}{295.7} = 102{,}152 \text{ B.t.u. for 1 cent.}$$

The second lowest cash price per ton proves to be the cheapest, since for each cent D will furnish 111,211 B. t. u., while his nearest competitor can only give 109,429—nearly 2 per cent less. The ash correction in these bids is 2 cents for 1 per cent. D is entitled to the contract, unless it be determined on trial that the fuel he proposes to furnish cannot be economically burned in the equipment at Buffalo.

The practice followed in certain places of basing the bid on the analysis of a small sample accompanying the bid is to be discouraged, as the coal dealer's sample is generally selected and appears better than the samples from actual delivery; the penalty that results is one source of discontent on the part of dealers. The more satisfactory plan is to have a guarantee accompany the bid with a geologic description of the coal to be furnished. Thus it is easy to see when a bid is doctored to make the ash correction a disadvantage to the *bona fide* bidders.

It should be noted at this point—as will appear from further illustrations of forms of contracts—that the amount of ash correction under several forms of contracts will seldom, if ever, affect the award as between two parties, unless their bids be very close, and in that case the benefit should be thrown to the coal of best trade record.

The following are a few forms of coal specifications covering large deliveries. The Interborough Rapid Transit Company purchases a year's supply of 360,000 tons of run-of-mine bituminous with the desired analysis on dry coal of carbon, 71 per cent; volatile, 20 per cent; ash, 9 per cent; B. t. u., 14,100 per pound; and sulphur, not over 1.5 per cent.

Premiums or deductions on heat value are based on a rate of 1 cent per ton for each 50 B. t. u. per pound of coal; for each ½ per cent of volatile matter in excess of 21 per cent, 2 cents per ton is deducted; for each ½ per cent of ash in excess of 9 per cent, 2 cents per ton is deducted; and for each ¼ per cent of sulphur in excess of 1.5 per cent, a deduction of 6 cents is made.

The inequitable features of this contract are excessive penalties in the case of sulphur and of volatile matter, and deductions without corresponding premiums in the case of volatile matter, ash, and sulphur. Furthermore, no incentive is offered to the dealer to deliver coal low in moisture since heat value is reckoned on the "dry" basis instead of "as received," whereas it was clearly pointed out that B. t. u. in commercial coal is the only true basis of potential heat.

The coal for the Panama Canal, consisting of bunker coal for vessels, locomotive coal, and fuel for dredges and steam shovels, aggregating 650,000 tons per annum, is purchased on a desired quality of 14,600 B. t. u. as received, with acceptance down to 14,350 B. t. u. on deduction of ¼ cent per 25 B. t. u. or fraction thereof. Coal analyzing below 14,350 B. t. u. and on a dry basis less than 14,750 B. t. u. is penalized 1 cent for each 25 B. t. u. below 15,000 in addition to the penalty above noted. This, in effect, is an ash adjustment, since previous experience had shown that the coal desired had a value, dry coal, of 14,900 B. t. u. This is a severe contract in that it gives no premiums, but is justified by the fact that, although the prices f. o. b. vessel at Norfolk were $2.72½ per long ton in 1908, $2.44 per long ton 1909, and $2.60 in 1910, the cost amounts to almost $6.50 per ton before the coal is distributed to shovels and dredges. This contract has resulted in an average delivery for 1908 of 14,547 B. t. u. as received, for 1909, 14,528, with a banner cargo in 1909 of 5,021 tons moisture 2.06 per cent, ash 3.69 per cent, B. t. u. as received 14,888, and B. t. u. dry coal 15,200.

The Government's coal purchases amount to about $7,000,000 per annum. Half of this is used in war vessels and is purchased by a system of visual inspection which will not permit of wet coal being loaded, and which pays a premium for all coal showing more than 15,000 B. t. u. dry. The remaining million tons is purchased on a *pro rata* "as received" B. t. u. basis and an ash variation allowing 2 per cent, then penalizing at rates increasing from 2 cents to 35 cents per ton for from 3 per cent to 9 per cent ash above guarantee. The criticism of this contract is that it has a rather large ash

EVAPORATION TESTS OF TWO COMPETING COALS.

Duration of test, hours	9	9	9	9
Name of coal	Elk Lick.	Orenda.	Orenda.	Elk Lick.
Analysis:				
Moisture	1.80	2.10	2.70	5.80
Ash	9.10	8.20	9.30	8.30
Fixed carbon	68.60	73.70	71.50	65.90
Volatile matter	20.50	16.00	16.50	20.00
B.t.u. as received	14,050	14,070	13,770	13,565
B.t.u. dry coal	14,310	14,370	14,150	14,400
Refuse:				
Combustible matter	22.75	30.10	20.80	21.00
Non-combustible	77.25	69.90	79.20	79.00
Per cent refuse	12.86	9.73	9.74	10.46
Boiler horse power	426.5	421.8	426.8	455.2
Equivalent evaporation per lb. coal as received	10.25	10.51	9.97	9.92
Equivalent evaporation per lb. dry coal	10.44	10.74	10.25	10.52
Equivalent evaporation per lb. combustible	11.98	11.90	11.35	11.75
Efficiency of boiler and grate, per cent	70.45	72.18	69.95	70.55
Contract price, per ton	$3.01	$3.15	$3.15	$3.01
Ash in dry coal, per cent	7	6	6	7
B.t.u. as received	14,000	14,300	14,300	14,000
Smoke, per cent black	15.2	1.7	3.62	13.8
Cost of evaporating 1,000 lb. of steam under observed conditions, cents	13.08	13.09	13.69	13.12

margin, that penalties are excessive for greatest departure from contract, ash premiums (1 cent per 1 per cent) are not in proper proportion to ash penalties, and ash penalties do not change with price.

A western firm handles large contracts for clients in Chicago and vicinity based on net B. t. u., which, to quote from their form is arrived at as follows: "Multiply the number of B. t. u. dry coal by the per cent moisture expressed in decimals, subtract the product so found from the number of B. t. u. per pound of dry coal, multiply the remainder by 2,000 and divide this product by the contract rate per ton (expressed in cents), plus one-half of the ash percentages (expressed as cents)." To drop the formidable language of the circular this amounts to making a correction to the price of one-half cent for each 1 per cent ash, and computing B. t. u. for 1 cent on the "as received" basis. Payments on delivery are adjusted in proportion of the net B. t. u. delivered to the net B. t. u. as guaranteed. The defect of this form is that it does not give an increasing deduction for increased percentages of ash over contract to provide for decreased boiler efficiency, and that one-half cent per 1 per cent is too low to cover the extra labor and cost of removal of ash under the most favorable conditions. In its practical applications however, it usually gives corrected prices which are very close to those under the form proposed and the one used by the United States Government.

To summarize the effects of these bases of payment, there are given data from a case which arose in a power plant this past summer. Among the half-dozen bidders was the agent then holding the contract, with a bid of $3.15 for 6 per cent ash in dry coal and 14,300 B. t. u. as received, and the nearest competitor $3.01, 7 per cent, 14,000 B. t. u., giving 9.84 and 9.66 cents per million B. t. u.—a ratio of 1.018. The first had supplied satisfactory coal for a year; the second from records in the Bureau of Mines was known to be slightly inferior and probably not so well adapted to the installation. But since there was a possible saving of 1.8 per cent, it was decided to leave the results to evaporation tests on two Babcock & Willcox boilers of 206 boiler horse power, fitted with mechanical stokers. The results are given in the table on the opposite page.

The average cost of producing steam with Elk Lick coal is 13.10 cents per thousand pounds and with Orenda 13.39 cents per thousand pounds, a ratio of $\frac{13.39}{13.10} = 1.021$, a saving in favor of the first of 2.1 per cent, whereas the expected saving was 1.8 per cent.

No Specifications.		Specifications.		Chicago Specifications.	
Price per ton	Evaporating 1000 lb. of steam	Price per ton	Evaporating 1000 lb. of steam	Price per ton	Evap. 1000 lb. of steam
$3.01	13.33 cents	$2.959	13.10 cents	$2.960	13.10 cents
3.15	13.73 "	3.036	13.39 "	3.047	13.44 "

Thus the specifications are seen to keep the cost of producing steam constant under variations of delivery—the original basis for the matter.

The question of correct sampling of coal is one to which could be devoted a great deal of time, for it has some very interesting phases. Any reliable laboratory can make a coal analysis, but such analysis for the purpose of forming a basis of payment is worse than useless unless the sample be absolutely representative of the coal in moisture content, proportion of lump and fine coal and amount of impurities. Not only must the sampler be fair and unbiased, but he should have had experience in the work.

The following general rules should apply:

Take no sample under 100 pounds.

A single sample should not represent more than 500 tons.

Sample at the time the coal is weighed.

Immediately reduce the sample, under shelter, to the size required by the laboratory.

No part of a sample once taken should be rejected—the law of chance applies, and if any part is worthless, all is worthless.

In many cases the coal dealers are antagonistic to specifications, and it is with great difficulty that they can be persuaded that this form of contract is equitable to both parties. In this respect they cannot be blamed when penalties are imposed without corresponding premiums. If the stipulations are fair, contractors will not hesitate; in fact such mining companies as employ competent fuel engineers and know the quality of their output solicit business on this basis. The anthracite combines will not guarantee the quality to dealers, consequently the latter have to stand any loss incurred in penalties.

A very natural question is "How much will the system cost?" That of course depends on the facilities of the plan for taking samples and making analyses. Many industrial plants already employ chemists, and the additional cost is the calorimeter apparatus, which can now be purchased in substantial form for $120. Commercial laboratories charge as much as $10 for a single analysis, but the rate is much lower where the work extends over a period. Some laboratories are prepared to take over the entire supervision of coal supply at a percentage of the annual saving effected; others go so far as to manage the plant for a fixed cost, taking as their fee the saving effected in firing, oil, and waste. The cost for a complete proximate analysis and calorific determination in the inspection laboratory of the Government is $1.95 per sample. This is probably as low a figure as can be reached.

The tonnage that may economically be purchased on specifications depends on the quantity delivered at one time. It has been successfully applied to an annual consumption of 500 tons, where the entire amount is placed in bunkers at one time.

In conclusion I present a table of prices and guarantees over the four years during which such fuel supply has been on specifications. The points of delivery are public buildings in Washington, New York and St. Louis, and with the single exception of the fourth plant, where coal is dumped directly from railway cars, all are supplied by wagons. The general trend of prices in the face of an advancing market is certainly worthy of careful consideration on the part of any purchasing agent who contracts with operators for comparatively large tonnage of coal.

City.	Tons.	1908. Price.	1908. Ash in dry coal. per cent	1908. B.t.u. as rec'd.	1909. Price.	1909. Ash in dry coal. per cent	1909. B.t.u. as rec'd.
Washington...	7,000	$3.55	6.0	14,600	$3.35	5.7	14,600
" ...	500	3.98	6.0	14,600	3.55	5.7	14,600
" ...	350	4.03	6.0	14,600	3.55	5.7	14,600
" ...	21,000	3.50	7.5	14,300	3.05	7.5	14,300
" ...	3,600	Not on specifications			3.65	8.0	14,200
New York....	11,000	3.45	6.8	14,315	3.43	8.0	14,000
"	2,500	Not on specifications			2.82	13.34	12,000
"	4,000	Not on specifications			3.10	18.0	11,150
St. Louis.....	4,500	2.55	12.0	12,500	2.53	7.74	12,061
			1910.			1911.	
Washington...		$3.04	5.0	14,750	$3.19	4.0	14,710
" ...		3.14	5.0	14,250	3.30	5.0	14,700
" ...		3.14	5.0	14,250	3.35	5.0	14,700
" ...		3.00	6.0	14,250	2.80	7.0	14,000
" ...		3.50	7.0	14,250	3.23	7.0	14,200
New York ...		3.37	6.0	14,000	3.31	6.0	14,100
" ...		2.80	15.0	12,000	2.44	17.0	12,000
" ...		3.05	18.0	11,150	2.90	16.0	11,500
St. Louis.....		2.20	10.0	12,585	2.43	10.0	12,000

ACTUAL B.T.U. FOR ONE CENT.

City.	1908.	1909.	Change from 1908.	1910.	Change from 1909.	1911.	Change from 1910.
Washington	92,124	97,624	+ 5,500	108,684	+11,060	103,293	− 5,391
"	82,171	92,124	+ 9,953	101,650	+ 9,526	99,782	− 1,868
"	81,151	92,124	+10,973	101,650	+ 9,526	98,293	− 3,357
"	91,520	105,023	+13,503	106,400	+ 1,177	112,000	+ 5,600
"		87,145		91,200	+ 4,055	98,477	+ 7,277
New York.	92,944	91,428	− 1,516	93,056	+ 2,628	95,420	+ 2,364
" .		95,320		96,000	+ 680	110,164	+14,164
" .		80,568		81,889	+ 1,321	88,828	+ 6,939
St. Louis...	109,804	106,785	− 3,019	128,138	+21,353	110,617	−17,521

PERCENTAGE CHANGE IN ACTUAL B.T.U. FOR ONE CENT.

1908-1909. Increase. per cent.	1908-1909. Decrease. per cent.	1909-1910. Increase. per cent.	1909-1910. Decrease. per cent.	1910-1911. Increase. per cent.	1910-1911. Decrease. per cent.	Total Period Increase, per cent.
5.97	....	11.33	....	....	4.91	12.12
12.11	....	10.33	....	....	1.84	21.44
13.52	....	10.33	....	....	3.30	21.17
14.75	....	1.12	....	5.26	....	22.40
.....	....	4.65	....	7.98	....	13.02
.....	1.63	2.88	....	2.54	....	2.66
.....	....	.71	....	14.75	....	15.58
.....	....	1.64	....	8.47	....	10.25
.....	2.75	19.98	....	....	13.68	.74

ACCOUNTING AND COST-KEEPING SYSTEM OF THE UNITED STATES NAVY.

By J. Mendenhall, C. P. A.

Published by permission of the Navy Department.

In Professor Hollis's valuable discussion of Secretary Meyer's organization of the United States Navy for higher efficiency, published in THE ENGINEERING MAGAZINE for February last, reference was made to the collateral betterment of the system for keeping the accounts of the navy yards and the Department. We are glad to present now what we promised a month ago—an authoritative description of the accounting and cost-keeping system of the United States Navy. Mr. Mendenhall is a member of the firm of Maverick, Mitchell & Co., by whom the system was devised and installed.—THE EDITORS.

ACCOUNTING and cost keeping for the Navy differs from that in other departments of the Government, and is more complicated than that of the average industrial establishment. There are several reasons for this, but the principal ones are that there must be a distinct line drawn between expenditures of a military nature and those of an industrial nature, and that each item must be charged to its proper appropriation as defined by law. The expenditures applicable to the quarters for the commandant and other officers attached to the yard, the marine barracks and quarters, the dispensary, the naval prisons, the guard houses, etc., are considered of a military nature and must be charged direct to the appropriations concerned; on the other hand, there are many expenditures applicable to the industrial part of the yard which cannot, under the law, be included as overhead or indirect expenses in the cost of productive work, as appropriations are specifically made for them by Congress. These latter consist of such items as salaries of officers, salaries of the clerical force, draftsmen, civilian assistants, sub-inspectors, expert aides, chemists, watchmen, messengers, etc., the principal part of which, in an industrial establishment, would be charged in the cost of work, through the medium of indirect expense.

It is evident, therefore, that when devising an accounting and cost-keeping system for the Navy it is essential to have a thorough knowledge of the laws governing appropriation expenditures and of the regulations of the Department. It is evident, also, that a cost system devised to take care of these special conditions will not afford proper comparisons with the results obtained by the cost system of an industrial concern engaged in similar work, namely, that of shipbuilders or engineers. At the same time, any system installed in the Navy should be such as will permit the chiefs of the bureaus in Washington, and the officers in charge of the work at the navy yards, to keep in close touch with the material and labor expenditures and the overhead expenses incident thereto.

In accordance with instructions from the Hon. George von L. Meyer, Secretary of the Navy, there has been installed a uniform system of accounting and cost-keeping in the Portsmouth, Boston, New York, Philadelphia, Norfolk, Charleston, Mare Island and Puget Sound Navy Yards. There has also been installed a more modern system of bookkeeping in the Bureau of Supplies and Accounts at Washington, where the complete financial transactions of the naval establishment are assembled and recorded.

Before attempting to describe the new system, it is advisable to outline briefly the organization of the Navy Department at Washington. The Department is administered by the Secretary of the Navy, who has, as his assistant, the Assistant Secretary of the Navy, and in addition four aides who act as personal advisors for the work of the divisions of Operation, Personnel, Material, and Inspection. In addition to these aides, the work of the Department is carried on by seven bureaus, as follows: Yards and Docks, Navigation, Ordnance, Construction and Repair, Steam Machinery, Supplies and Accounts, Medicine and Surgery, and the Headquarters of the Marine Corps. The work of each of these bureaus is under the immediate control of an officer appointed by the President, and confirmed by the Senate. These officers are responsible for the expenditures made against the appropriations under the cognizance of their respective bureaus. From the amount appropriated annually by Congress the respective Chiefs of Bureaus at Washington make monthly allotments to be expended at each navy yard or station. The amounts of these allotments are based on the expenditures made during the previous months and on requests for funds for work to be done under each appropriation, by the commandant or manager of a yard or station. They cannot be exceeded by yard commandants without first obtaining authority from Washington.

NAVY-YARD ORGANIZATION.

The organization of the navy yards is as follows: The commandant or general manager; the captain of the yard, who acts as aide or executive to the commandant and is also in charge of the yards and docks department, the manufacturing department, the inspection department, the general storekeeper's department, the pay department, the accounting department, and the medical department.

The manufacturing department is divided into two divisions, namely, hull and machinery. The hull division is in charge of the senior naval constructor on duty at the yard, who is directly responsible to the commandant or manager for the operation and work of this division. The following shops have been assigned to the hull division:

Saw mill
Ship wrights
Spar
Boat
Mold loft
Block
Joiner
Sail loft
Rope walk
Blacksmith (hull)
Plumbers
Upholstering
Galvanizing
Ship fitters
Sheet metal
Paint
Rigging loft
Anchor and chain

The machinery division is in charge of the senior line officer detailed for engineering duty, with a responsibility to the commandant or manager similar to that of the officer in charge of the hull division The following shops have been assigned to the machinery division:

Blacksmith (machinery)
Boiler
Coppersmith
Instrument makers
Foundries
Ordnance
Machine
Pipe fitters
Tool makers
Electrical
Pattern

Function of Accounting Department.

The accounting department is in charge of an officer of the pay corps, and is under the direct supervision of the commandant or manager. The accounting officer has full charge of all accounting matters and cost-keeping records, the preparation of all reports of expenditures and statements of operating expenses, as well as the preparation of the yard pay roll. For convenience in handling the work, the accounting office at each yard is divided into several sections as follows:

Time
Material
Posting
Appropriation
Correspondence

Job orders are issued by the officer in charge of the hull and machinery divisions for all manufacturing, repair, or productive work, and a copy is forwarded to the accounting officer. These job orders are so prepared that they become folios in a loose-leaf binder on which the accounting office makes the charges incurred in carrying out the work. Each job order is consecutively numbered, the job-order system being such that the number will show the appropriation, the number of the ship or account to be charged, the division issuing the order, the serial number, and the title. This is important, because the cost of work must be recorded by appropriations, by ships, and by the title of the work. These job orders show a complete specification of the work required, as well as an estimated cost of the work. Where practicable to do so, these estimates are divided between labor, indirect expense, and material, and also by shops through which the work must pass.

Time and Material Records.

The time is reported daily, by each workman, in the form of an individual time ticket which embraces the labor performed by each man on a specific job. Separate time tickets are used when more than one job is worked upon during the day. The tickets are approved by the foreman, leadingman, or quarterman, and are forwarded early the following morning to the time section of the accounting department, where they are calculated and proved for each shop on a revised form of pay roll. Daily, they are also balanced with the total wages computed according to the number of employees in the yard, thus keeping an accurate account of the labor expended.

The advantage of this revised form of pay roll was demonstrated at the Boston Navy Yard, when an order was received from the Navy Department on December 22, 1909, authorizing the payment of the employees before Christmas. The pay roll, having been compiled and balanced daily, permitted the making of the official roll for the paymaster of the yard in the half of one working day. This would have been quite impossible under the previous system of handling the pay roll.

After the tickets are sorted to jobs, by means of job-order numbers, they are forwarded to the posting section, where they are posted daily, to the respective job orders, by shops. These job orders are of two classes, those under appropriations and those under shop, power plant and general expense, known as "Indirect Expenses." After being posted, the time tickets are passed to the appropriation section, where they are charged in totals to the appropriations and to the shop, power-plant, and general expense accounts, after which the postings made to the various job orders by the posting section are balanced with the postings made to each appropriation and to the expense accounts. From the above, it will be seen that the total daily pay roll is balanced with the total of the postings made to the various job orders and appropriations. Thus, the accuracy of the work is beyond question.

Material issued to the shops is handled in exactly the same manner as the labor. All material is issued by the general storekeeper on the authority of properly approved stub requisitions. After these requisitions are priced and extended by the general storekeeper, they are forwarded to the accounting office, where they are charged to the proper job orders and to the appropriations or expense accounts, the total charges being balanced daily with the storekeeper's record of issues.

Indirect or Overhead Expenses.

The indirect or overhead expenses are classified under three headings: Shop Expenses, Power-Plant Expenses, and General Expenses.

The cost of operating each shop in each division is kept separate, and all expenditures incurred for labor and material are located daily to the following accounts:

Supervision
Maintenance of Equipment
Maintenance of Furniture and Fixtures
Maintenance of Loose and Hand Tools
Maintenance of Machine Tools
Maintenance of Buildings
Maintenance of Elevators
Miscellaneous Shop Expense
Power (Independent Plants)
Fuel

Statements are prepared and submitted monthly to the heads of divisions, showing the expenditures incurred, for each shop in their division, during the month on each of these accounts, as well as the previous month's expenditures, the increase or decrease in the current month as compared with the previous month, and the accumulated charges for the fiscal year to date.

The cost of operating the central power plant is kept under a separate group of accounts, and the expenditures for both labor and material are located daily as follows:

Maintenance of Power Plant Buildings
Maintenance of Sub-station Buildings
Maintenance of Power Plant Boilers, Flues and Stacks
Maintenance of Power Plant Piping
Maintenance of Power Plant Machinery
Maintenance of Distributing System—Heat
Maintenance of Distributing System—Electric
Maintenance of Distributing System—Pneumatic
Maintenance of Distributing System—Hydraulic
Maintenance of Water System
Maintenance of Sub-station Motors and Accessories
Maintenance of Tools, Furniture and Fixtures
Fuel
Power Plant Supplies
Oils, Grease and Waste
Attendants on Light and Power Plant
Supervision

A statement is prepared monthly and reported to the head of the machinery division showing, separately, the total labor and material expenditures on each of the above accounts for the current month, the total of each account for the previous month, and the increase or decrease in each account for the current month, as compared with the previous month, and also the total expenditures for the fiscal year to date.

Power is distributed to shop expense in each shop on the basis of meter readings for electricity, water and pneumatic power; heat is distributed on the basis of the cubical contents of the buildings, taking into consideration the nature of the building and the kind of work performed therein, or the purpose for which it is used.

In addition to the above mentioned classifications, there are many miscellaneous expenditures which cannot be located to a specific shop. These are separately accounted for under the heading of "General Expense," the expenditures for labor and material being located daily to the following accounts:

Maintenance of Miscellaneous Buildings
Maintenance of Elevators
Maintenance of Furniture and Fixtures
Maintenance of Telephone System
Maintenance of Roads, Walks and Gutters
Maintenance of Sewer System
Maintenance of Tracks
Maintenance of Railroad Rolling Stock
Maintenance of Weighing Apparatus
Maintenance of Hoisting Apparatus
Maintenance of Floating Property
Maintenance of Live Stock
Maintenance of Vehicles
Handling Materials, (not chargeable to Specific Shops)
General Office Expense, Accounting Department
General Office Expense, Hull Division
General Office Expense, Machinery Division
General Office Expense, Inspectors' Department
General Office Expense, Yards and Docks Department
General Office Expense, Yard Pay Office
General Office Expense, Labor Board
Drafting Room Expense, Hull Division
Drafting Room Expense, Machinery Division
Drafting Room Expense, Yards and Docks Department
Inspector's Department Expense
Testing and Inspecting
Maintenance of Testing Laboratories
Examination of Apprentices

A similar monthly statement is submitted to the heads of divisions showing the total labor and material expenditures charged to each of the above accounts, the total charged to each for the previous month, the increase or decrease in each account for the current month, as compared with the previous month, and the total expenditures for the fiscal year to date.

General expense is added to shop expense in each shop on the basis of productive labor performed therein.

The indirect charges applicable to each shop, therefore, consist of (1) its direct shop expense, (2) its proportional part of the power-plant expenses and (3) its proportion of general expense.

The statements for the operating or indirect expense at each yard are in the hands of the officers concerned from the third to the sixth of the month following that in which the expenditures were incurred. Previous to the introduction of this system, the officers in charge of the divisions of the yard were not in possession of any of this information, nor were the accounts kept in such a manner as would show the cost of operating individual shops, nor as to how the operating expenses of these shops compared with the productive labor performed therein. It was, therefore, utterly impossible to expect economies to be effected in operating the shops in the various yards. Since these statements have been furnished to the officers, it is a well-known fact that the operating expenses in many of the yards have been reduced.

APPLICATION OF INDIRECT CHARGES TO COST OF WORK.

The indirect charges are applied to the productive work of the yard on a percentage basis, depending on the shops through which the work passes. The percentage for each shop is obtained by dividing the shop expense by the productive labor performed therein. This percentage is then applied to the productive labor performed by each shop, thus giving the indirect charge to be located against the job. For example: Suppose a job is done at the New York Navy Yard, requiring the work of the riggers, ship fitters and joiners; assume that the percentage to be used for the riggers' shop is 20 per cent, that for the ship fitters 30 per cent, and that for the joiners 45 per cent; and that the productive labor and material consumed by each of these shops are as follows:

	Labor.	Material.
Riggers	$10.00	$50.00
Ship Fitters	70.00	30.00
Joiners	100.00	150.00

By applying the above percentages to the labor performed in each shop, the total cost of the order would be:

	Labor.	Indirect Expense.	Material.	Total.
Riggers	$10.00	$2.00	$50.00	$62.00
Ship Fitters	70.00	21.00	30.00	121.00
Joiners	100.00	45.00	150.00	295.00
Total Cost	$180.00	$68.00	$230.00	$478.00

There are several methods of absorbing the indirect expense over the cost of work, such as the machine-tool rate, hand-labor rate, hourly burden, etc., depending on the conditions requiring their use, all of which are correct, but the method of absorbing the indirect expense over the cost of work on the basis of productive labor, as herein described, is believed to be sufficiently accurate—especially so when it is taken into consideration that this method is in operation in some of the largest and most successful industrial manufacturing establishments in the United States, and that it requires considerably less clerical work to operate it than most other methods.

Items Not Included in Indirect Expense.

As previously stated, in devising this system it was not the intention that the indirect expense applied to the cost of work should include all the charges properly applicable thereto so that the cost could be compared with that in similar industrial establishments. To include all such charges would be a direct violation of the law governing appropriation expenditures, and it is therefore impossible to obtain all the results desired until such time as Congress amends the laws accordingly. Among the items which are not included in the direct expense and are therefore not applied to the cost of productive work, are, as already mentioned, the salaries of officers, these being chargeable to the appropriation "Pay of the Navy." For the wages of the clerical force, draftsmen, civilian assistants, sub-inspectors, expert aides, chemists, watchmen and messengers, Congress has specifically appropriated amounts under the various main appropriations; and in the appointment of these employees, the appropriation from which they are to be paid is designated by the Department. Furthermore, the Attorney General in his decision of February 28, 1910, has, by implication, decided that these payments should be located against the proper appropriations.

All navy-yard employees receive pay for seven national holidays; laborers and mechanics are allowed fifteen days' leave with pay after one year's service, but no sick leave; per diem classified employees (clerks, draftsmen, inspectors, messengers, etc.) are allowed fifteen days' leave, and, in exceptional and meritorious cases, can be granted fifteen additional days on account of sickness; per annum classified employees at navy yards are allowed thirty days' leave, and, in exceptional and meritorious cases, can be granted thirty days additional on account of sickness; by executive order, four hours (exclusive of time for luncheon) constitutes a day's work on Saturdays, during the months of July, August and September, for all clerks and other employees of the Federal Government wherever employed, with the proviso that the order shall not apply to any bureau or office of the Government, or to any of the clerks or other employees thereof, that may for special public reasons be excepted therefrom by the head of the Department having supervision or control of such bureau or office, or where the same would be inconsistent with the provisions of the existing law.

It will be seen therefore that all per diem employees of the navy yards are entitled to twenty-seven days' leave and holiday per annum. As no such conditions exist in commercial establishments, it would be inconsistent to charge these expenditures to the cost of productive work.

In addition to the above, unclassified employees are paid full pay if injured in the line of duty, while engaged on Government work, and if killed, their heirs are paid one year's salary at the per diem rate the employee was receiving at the time of his death.

The cost of this leave, holiday and disability is not included in the indirect expense, but is charged daily directly to "Increase of the Navy" appropriations and the main appropriation of each bureau on the basis of productive labor performed.

The expenses of receiving, testing and handling stores purchased under the Naval Supply Account, must be charged against the appropriation "Provisions, Navy" in accordance with the decision of the Attorney General under date of February 28, 1910. While we appreciate the fact that storekeeping expense is properly charged to indirect expense, this is not permissible in the navy system, owing to the above decision. A classification of accounts has been established, however, to record all storekeeping expenditures, and should a law be passed authorizing their inclusion in the indirect expenses, it will not necessitate any change in accounts or addition of new accounts to the system. It may be mentioned, however, in this connection, that a large proportion of storekeeping expense is of a military nature, such as the issuing of supplies, provisions, coal, oil, etc., to ships in commission and, therefore, a division would have to be made between military and industrial.

Fire-insurance premiums and depreciation on property and plant are also not included in the cost of work, as these items have been declared to be illegal by the Attorney General in his decision of the above date. Interest on money invested also is not taken into consideration. Nor is there any allowance made for taxes on the property owned by the Government and occupied as navy yards.

To have fire-insurance premiums and depreciation included in the cost of work would necessitate that Congress provide a law making this procedure legal. Expenditures for replacements of buildings or other property are now paid for from specific appropriations. Expenditures for replacement of machine tools and shop or yard equipment are now charged to the appropriation concerned, under the bureau authorizing the expenditure. In order to determine what charges shall constitute replacements, a limit of $100 has been placed upon certain expenditures chargeable to the classification of accounts under shop, power, and general expenses—that is, if a repair job on a machine tool, building, or other equipment is estimated to cost $100 or more, the officer in charge has instructions to issue a special job order, charging the cost of this order to the appropriation under which the expenditure was authorized.

It has been stated that by setting this limit of $100 the officers in charge of the different shops may evade paying for expenditures from their appropriation, by splitting the work over several jobs and charging it to shop expense. Should this be the case, the officer in charge of the work, who approves the job order, would be violating the regulations. By doing so, he would also be increasing his shop percentage, and it necessarily follows that such a procedure would be detrimental to the economical operation of his shop. By comparing the increases or decreases as shown in the shop percentage statements previously described, the manager of the yard can immediately discover any appreciable increase, and hold the officer in charge strictly to account.

Reports on Work in Progress.

At some of the yards the officers in charge of the work have requested that they be advised daily of the total labor, indirect expense and material charged to each job order under jurisdiction. Objections have been raised, however, to furnishing them this information, as it provides the foreman, leadingman, or quarterman, in charge of the work in each shop, a means of diverting charges from one order to another, so that their work may compare favorably with the estimates; and because, to supply this information, it would be necessary to increase the clerical force of the accounting department to such an extent that the expenditure would be entirely out of proportion to the results obtained. Such a practice is also not in accordance with the regulations observed in well managed industrial concerns.

When the expenditures on a job order are within 70 per cent of the estimated cost, the accounting officer informs the heads of the divisions to that effect. This enables the officer in charge of the work to investigate its progress, and if the work is not within 70 per cent of completion, to ascertain the cause for the over-expenditure. The cost of work records kept by the accounting officer are at all times open to the inspection of the officers in charge of the work, so that they can keep in close touch, and compare the expenditures with the progress of their work.

Upon completion of each job order, a notice is sent to the inspection officer, who, after inspecting the work, notifies the accounting officer of its completion. A report is then made out which shows the job-order number, the ship or heading, the specification, the estimated cost, and the actual costs, by shops, divided between labor, indirect expense and material. These reports are forwarded without delay to the heads of divisions at the yards, and to the bureau concerned, at Washington. This permits the latter to make a careful scrutiny of the charges shortly after a job is completed, and enables them to correspond immediately with the yard in cases where it is necessary.

Prior to the introduction of this system, no such detailed reports were available, either for the use of the officers of the yards or for the use of the chiefs of the bureaus concerned at Washington.

At each navy yard there are from two- to five-thousand active job orders at all times. From this number of active job orders one can readily appreciate the amount of clerical work involved.

In order that the officers in charge of the work, and the manager of the yard, may be informed daily of the expenditures made against each appropriation, the accounting officer, after balancing the appropriation charges for labor and material drawn from stores as already described, prepares a report showing the amount allotted from each appropriation for the month, divided between labor and material, the daily expenditures and the amount expended to date, as well as the available balance. These reports are made, in most cases, within from twelve to fourteen working hours after the expenditure has been incurred, and inasmuch as they are balanced with labor and material records, it necessarily follows that they are correct. Therefore, the officers in charge of the work are kept well informed of costs and expenditures, and they are certainly given the opportunity of becoming more familiar with the cost of their work than the average superintendent or manager of an industrial establishment.

Monthly Report of Expenditures.

At the close of each month the accounting officer prepares a report which shows the expenditures, separately, for labor, material, and indirect expense for each appropriation under which work was performed. This report is in such detail that it affords each bureau the information necessary for the proper management of the work under its control and also permits the recording of expenditures such as is required for the preparation of the annual report of the Paymaster General.

In this connection it is necessary to explain that navy expenditures are made under a system of headings which are standard throughout the service. First, there is a system of titles which represent various classes of expenditures. These titles are represented by capital letters of the alphabet. For example: Title "D" represents Repairs to Ships, Title "E" represents Real Estate and Chattels, Title "F" Machinery Plant, and Title "G" General Maintenance, etc. In establishing the accounting system, it was found necessary to increase the headings under several of these titles, in order to classify the expenditures more clearly. In preparing the various periodical reports required, the expenditures are arranged first by titles and then by standard headings under titles. For example: In the case of Ships' Repair Work, there are three main headings with ten sub-headings under each of these main headings. The expenditures also have to be shown under each ship. The report of expenditures in the case of Ships' Repair Work, would read therefore as follows: Title "D," meaning Repairs to Ships, the name of the ship, the main headings, namely, Wear and Maintenance, Changes and Additions, or Casualties; with the sub-heading, such as Boilers, Engines, Hull and Fittings, Auxiliary Machinery, Wireless Telegraphy, etc. Likewise, work performed under Title "E," Real Estate and Chattels, would show the title, then the standard heading, such as Railroad Rolling Stock, Hoisting Apparatus, Yard Equipment, Buildings, etc.

At the end of each month, the total expenditures for all appropriations are balanced with the grand total of the pay roll and with the value of material issued by the general storekeeper. This is done because expenditures must be reported to the Treasury under the headings of labor and material only; consequently, the indirect expense must be divided between labor and material. This is accomplished by dividing between labor and material the total indirect expense charged to each appropriation, in the same proportions in which labor and material exist in the total indirect expenses of the yard. These expenditures are, however, recorded in the Bureau of Supplies and Accounts at Washington, so as to show, separately, under each appropriation, the labor, material and indirect expense, in accordance with the law.

These reports are forwarded to all bureaus having cognizance of the various appropriations involved, in from five to ten working days after the close of the month. Under the previous system, it required from twelve to twenty-five working days for the preparation of the reports, and even then they were compiled in less detail than those now furnished.

Books of Accounts.

To perfect the cost-keeping system at the navy yards, and to carry it to a logical conclusion, it was necessary to introduce a complete double-entry bookkeeping system of accounting. This system is arranged to provide for the recording of all property and plant accounts at each yard. There are but three books used, namely, a general ledger, a subsidiary ledger, and a journal. The general ledger contains the various controlling accounts for Property and Plant, Work in Progress, and Operating Expenses, while the subsidiary ledger contains the details of the property and plant and the operating-expense accounts. Entries for the ledgers are made, monthly, from the cost of work records by journal vouchers, and the ledger accounts are intended to show, monthly, the total value of the work in progress and of completed work, the total operating expenses, appropriation charges, pay rolls and materials consumed. A trial balance of each ledger is prepared monthly and forwarded to the Bureau of Supplies and Accounts.

Naval Supply Account.

Prior to April, 1910, the manufacture and repair of articles for stock at navy yards and the purchasing of large quantities of naval supplies was conducted through the medium of the Naval Supply Fund, a fund created by Acts of Congress, with an authorized limit of $2,700,000.

In February, 1910, the Secretary of the Navy asked for the opinion of the Attorney General in regard to the legality of the manner of conducting the affairs of this fund. The fund had increased so that its worth on March 31, 1910, was approximately eleven and a half millions. This increase was due to several causes, but principally to the consolidating, under it, of what was technically known as "Common General Stock," namely, stock bought under annual appropriations of previous years and held for use but not chargeable against an appropriation when drawn from store.

The Attorney General on February 28, 1910, decided that the method of operating the Naval Supply Fund was not sanctioned by law. It therefore became necessary to return to Common General Stock a portion of the stores in the fund, and to obtain an Act of Congress that would permit the purchase of stock or expenditures for manufacture and repair of articles for stock for the naval establishment, under one fund or account. The following legislation was therefore obtained:

> All stores on hand July first, nineteen hundred and ten, shall be charged to a naval supply account on the records of the Bureau of Supplies and Accounts, and all purchases of stock or expenditures for manufactured or repaired articles for stock at navy yards or stations, during the fiscal year nineteen hundred and eleven, and nineteen hundred and twelve, shall be charged to this account and be paid for from "General Account of Advances."
>
> The amount so advanced during the fiscal years nineteen hundred and eleven and nineteen hundred and twelve shall be charged to the proper appropriations as these stores are consumed from stock, and when disbursements made for all other purposes are accomplished, the amount so charged shall be returned to "General Account of Advances" by pay or counter warrants; PROVIDED, however, That such material as provisions, clothing and small stores, medical stores, and such other materials as the Secretary of the Navy may designate, may be purchased by specific appropriations or transferred to specific appropriations before such materials are issued for use or consumption. The said charge, however, to any particular appropriation shall be limited to the amount appropriated therefor.
>
> Credit shall be made to appropriations during said fiscal years nineteen hundred and eleven and nineteen hundred and twelve for the value of surveyed material taken from repairs made to Ships or Plant at navy yards and stations, or for stores turned in from ships, and this credit shall not be used by the Bureaus to increase the amount of that appropriation, but shall be a deduction from the operating expenses of the annual appropriation concerned, subject to the same provision as stated in above paragraph.—Deficiency Act, June 25, 1910.

The advantages of purchasing supplies for the navy under one account are obvious, as it places the matter on a business basis. Under the system of "Common General Stock," the various bureaus were in the habit of making requisitions for quantities of supplies of the same kind and character. The general storekeepers were required to submit such requisitions under each bureau appropriation, and the supplies had to be contracted for, stored and accounted for, separately. The quantities required were comparatively small, and consequently higher prices had to be paid than would have been the case if larger quantities could have been purchased. It is a well founded business principle that in order to obtain the cheapest prices, the invitation to bid should be as attractive to the manufacturer as possible, and large quantities should be bought when it is safe and practicable to do so.

Further, by the establishment of this one account, known as the Naval Supply Account, the method of keeping accounts, both for stores purchased, manufactured or repaired, is greatly simplified; clerical labor is reduced, economy in both time and money is obtained.

It should be remembered that the Navy must be ready for duty at all times and that it has many outlying stations throughout the world; therefore, it is required to maintain a large stock of supplies in order to meet emergencies. By the operation of the Naval Supply Account, it has been possible, by the consolidation of stores, to reduce the actual quantities carried and at the same time fulfill the above mentioned requirements of the service.

In consequence of the passage of the act establishing a Naval Supply Account, and the system of accounting in navy yards, a radical change was made necessary in the bookkeeping of the Navy Department. A system has been devised, founded on the most modern bookkeeping practice. It will enable the Bureau of Supplies and Accounts to furnish the Department, or any of its bureaus, information desired regarding the expenditure of funds chargeable to the various appropriations, both as to direct and indirect charges, and the value of material or stores consumed. The system will also establish a set of personal accounts with every disbursing officer under the Navy Department, and will show the value of stores on hand at the various yards, under the accounts established, and the increase or decrease of such stores. These improved methods will enable proper debit and credit entries to be made, both as regards material and money; thus a reliable double-entry bookkeeping system that will permit of the taking of a proper monthly trial balance is established for the first time in the history of the Navy.

Before establishing this system, which, it might be well to add, is based on the special needs of this branch of the Government, it was necessary to consult the accounting officers of the Treasury, and so arrange the naval accounts as to accord more directly with the books of that Department. This will in all probability result not only in prompt adjustment of appropriation charges, but in more expeditious, and therefore in more satisfactory settlement of naval officers' accounts.

RECENT MECHANICAL IMPROVEMENTS IN THE MANUFACTURE OF ILLUMINATING GAS.

By Jacques Boyer.

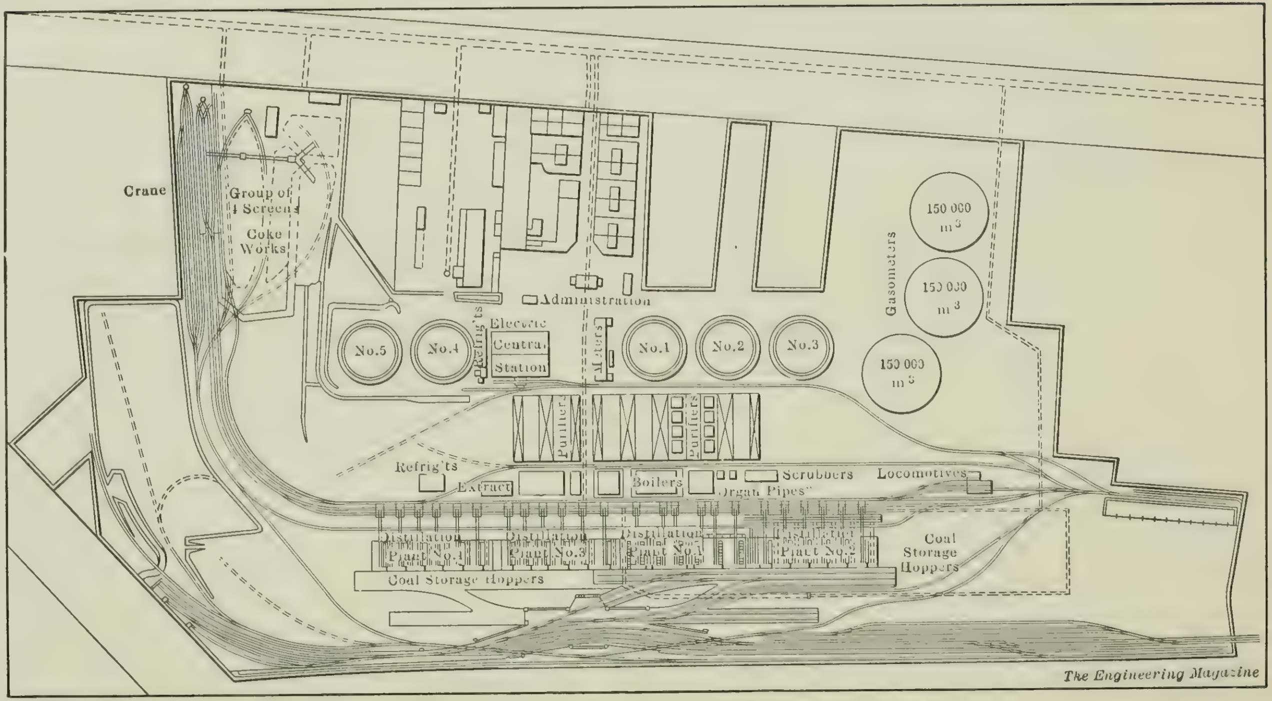
The article following is interesting not only of itself, but as a supplement to the preceding series by Mr. Rollin W. Hutchinson, Jr., in which the rapid advance of electric illumination was summarized. Professor Boyer shows, in contrast, the corresponding progress made in the manufacture of illuminating gas—a progress resulting partly from the reflex or competitive influence of the development of electricity, and characteristically illustrative of the constant widening of the field occupied by the mechanical engineer.—THE EDITORS.

RAPID increase in the population of Paris during recent years has been followed by a corresponding increase in the use of gas, which in turn is favorable to reduction of costs; thus, from 1902 to 1909 the number of consumers grew from 454,651 to 631,127, and the cubic metres of gas consumed passed from 303,000,000 to 429,000,000. If the same rate of growth continues, illumination and heating by means of gas will require about 550,000,000 cubic metres in 1920.

To respond to such demands it has been necessary to increase the productive capacity of the Landy works, to improve the apparatus in the works at Clichy and La Villette, and to provide for the early replacement of six out-of-date plants, situated within the city, by the huge Cornillon plant, which installation is built on an area opposite the Landy works, and by another plant situated in the southwest part of Paris.

As a beginning, the municipal administration proceeded to buy up the old and new "Compagnie Parisienne d'Eclairage et de Chauffage par le Gas," whose concession dating from 1855 expired December 31. 1905, though it continued operation under provisional charter up to August 31, 1907. Its equipment was turned over under certain conditions to the new Société du Gaz de Paris, which now administers the monopoly in the interest of the city.

Paris, desiring to maintain her old reputation as *la Ville Lumière,* is appropriating 180,000,000 francs for the reorganization of this service. To the north of the city will be built the new Cornillon works occupying an area of 46 hectares, and producing at the outset 350,000 cubic metres, which will be gradually increased to 700,000 metres.



The Engineering Magazine

GENERAL ARRANGEMENT OF THE LANDY GAS WORKS, PARIS.

For the present, the Landy works have been trebled by the installation there of three new sections, which, when finished, will enable it to supply 700,000 cubic metres per twenty-four hours. The horizontal retorts at La Villette will be replaced by high-power inclined retorts. Finally, the plants at Passy, Vaugirard, Boulogne, Saint-Mandé, Alfortville, and Ivry will be dismantled because the manufacture of gas with the apparatus there installed is inordinately expensive, even when taking into account the fact that none of these esablishments has a railway connection and that the last two are far distant from the Seine, the cost of transporting coal being therefore excessive. The sum to be recovered by the city from the sale of the sites and the machinery at these plants is estimated at 20,000,000 francs.

Let us now review the Landy works, where the retorts require daily from 900 to 1,000 metric tons of coal, furnishing at present 300,000 cubic metres of gas. This output will soon be increased to 700,000 cubic metres, requiring 2,400 metric tons daily. The plant covers an area of 48 hectares north of Paris, near Saint Denis. The arrangement of the buildings is indicated on the plan, while the accompanying photographs show the most interesting of the novel mechanical appliances installed, to which further reference will be made in the description of the operation. The plan shows immediately that the various buildings and processes are arranged in parallel. At the entrance are seen the coal piles and chutes, then the distilling plant, followed by the purifying apparatus, and finally the gasometers and distributing arrangements. Coal is received at Landy from the north, from Great Britain or from Westphalia, either by canal or rail. The company owns its own railway wagons and ten locomotives. As a provision against mine strikes or suspension of railway or water traffic, coal is stored in the open air, in piles, or in covered silos and hopper storehouses in the front of the plant. The fuel passes directly from these hoppers to the retorts through a series of mechanical-handling appliances designed to eliminate the hand labor formerly so costly in this industry. The full railway wagons pass over an elevated track, where they are weighed. They are then discharged laterally into hoppers, or huge funnel-shaped bins placed below the track. An operator stationed in a controlling office directs the coal into the series of conveyors serving each battery. Descending first to crushers, it is automatically elevated to the top of the plant and distributed to towers near the retorts awaiting its distillation.

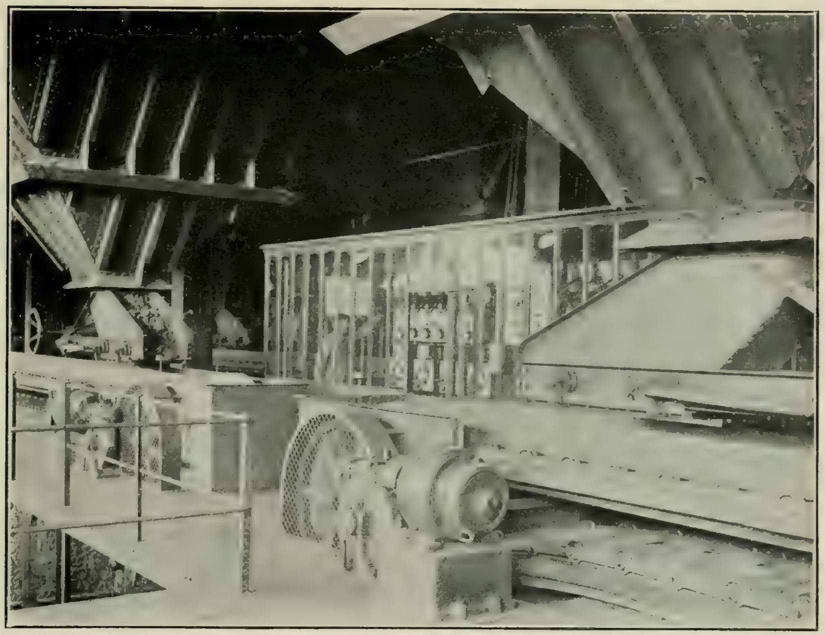
These transporters, which handle about 600 metric tons daily in each section of the plant, occupy a building parallel to the distillation house and equal to it in length. Some of the conveyors handle lean coal and some rich coal. The two kinds are mixed in proportion regulated at will according to the speed of the conveyor and the quality of gas desired. Each section of the works has thirty-six hoppers, arranged in three parallel rows of twelve, above six conveyor lines running parallel to the longest dimension of the building. These conveyors or endless belts are electrically driven.

Discharging the hoppers is the only manual operation in this part of the plant. All other handling is mechanically accomplished. The coal as discharged falls upon the conveyor, while a distributor, with a backward and forward movement imparted by the endless chain of the conveyor itself, gives an alternating motion to the gate of the hopper, thus preventing the coal from wedging in the chute. The six longitudinal conveyors discharge the lumps into two similar transverse lines installed on a lower level. These latter carry the coal toward the distillation house and deliver it to the two jaw crushers, which reduce it to a suitable size. A Hunt chain bucket conveyor, running the length of the building, passes underneath the transverse conveyors and crushers, and raises the crushed coal from the basement of the works to the top, where the towers are placed in which the coal awaits transportation to the retort.

As each section of the distillation plant contains six batteries of six furnaces each, the six corresponding towers, placed in line underneath the upper part of the Hunt conveyor, must each receive regularly its hundred tons of coal, that being the quantity necessary for twenty-four hours' distillation. The operator discharges a tower very simply by electrically-operated devices, the entire control being centralized at an operating switchboard in the middle of the plant.

Let us now examine the four distillation houses, all alike, which compose the Landy works. Within the huge area of each are placed six batteries, ranged in parallel and surrounded by a free space serving for charging and emptying of the retorts. Each battery contains six furnaces of nine horizontal retorts each, six metres long, heated by gas from a Siemens coke-fed producer beneath

A battery force formerly was composed of two firemen, six chargers, six dischargers, and two coal passers who brought in the coal for the retorts. Finally, another workman, called ironically in technical slang the *"Mylord,"* cleaned up around the furnace, stopped leaks, and did any other necessary detail work. Three chargers were required to handle the *cuiller,* a semi-cylindrical scoop three metres in length. It was filled in advance with 75 kilogrammes of

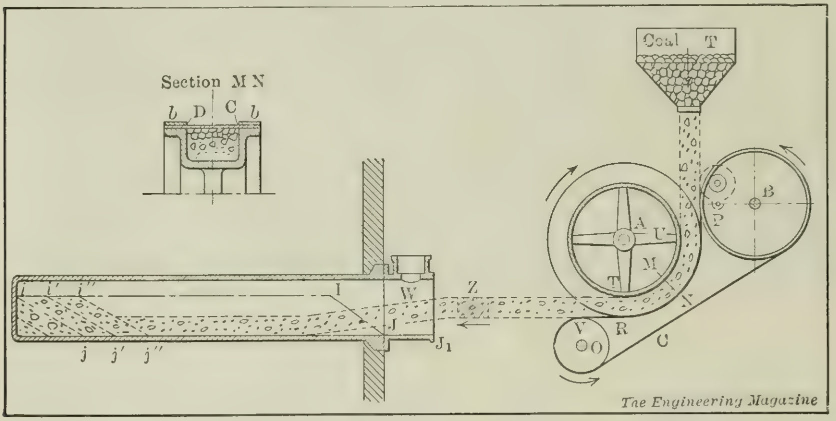


COKE CONVEYORS, AND OPERATOR'S CABIN.

coal (half a retort charge); when the coke produced from the preceding charge had been withdrawn from the retort by a discharger, two chargers raised the scoop by means of a cross-bar placed underneath, and a third seized the grip which terminated the handle of the instrument. Then all three advanced toward the retort and with mathematical precision charged the coal into it in the twinkling of an eye. The end workman would turn the handle at the precise moment to discharge the load which his two companions carried, and would dexterously turn the contents of the scoop into the retort, and in less time than it takes to write it, they would charge a second scoopful; the discharger would quickly close the door of the retort, and two or three turns of a screw sufficed to close it hermetically. They passed then to the next retort and in an hour and forty minutes the whole battery would be charged. At the end of four hours distillation was complete, and at the fireman's whistle charging was begun again.

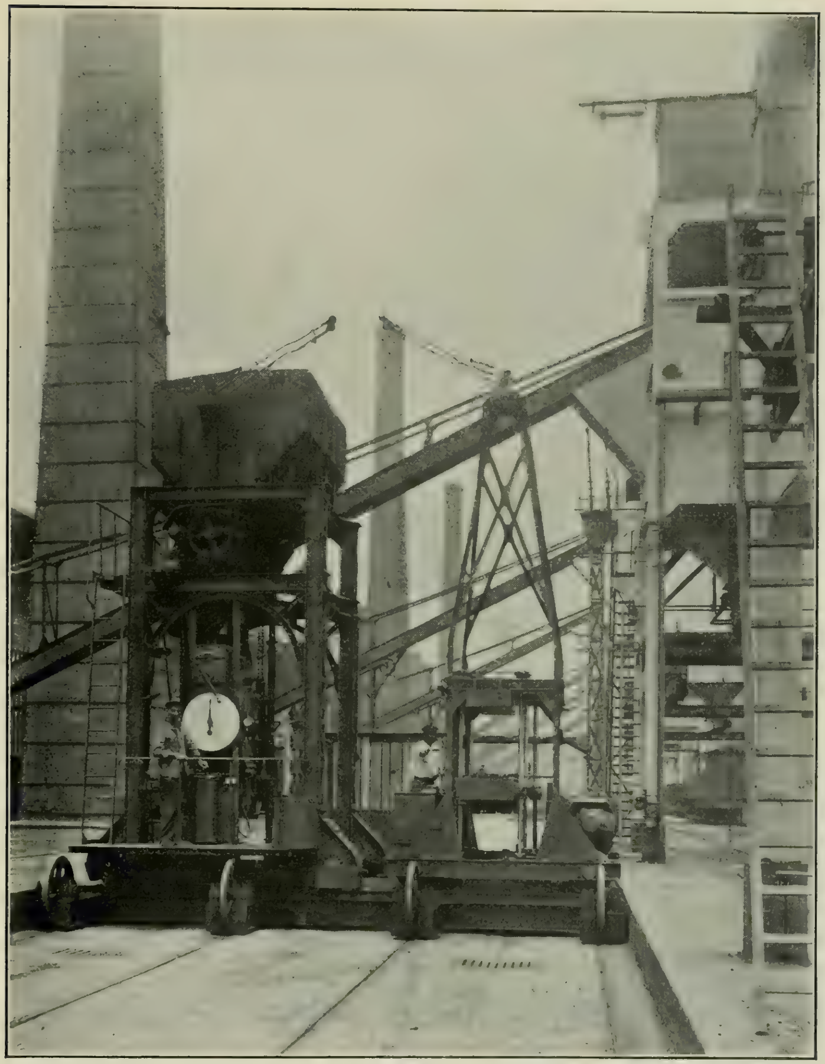
The retorts must first be emptied. Each discharger, a red-hot iron in his hand, approached the retort under his care and lighted it, the orifice being very gently opened part way so as to avoid the explosion which would be caused by a sudden entrance of the air. This being done, the man opened wide the discharge door, and, without stopping, proceeded to the same operation on the next retort. At this moment a second discharger approached rolling a *marmite* (a heavy steel basket mounted on two wheels), into which he pulled with a long tool the 2½ hectolitres of coke constituting the first residue of distillation.

Nowadays, the task is much easier. At Landy the retorts are filled with the aid of Brouwer chargers, and are emptied by the Sautter-Harlé dischargers. A Brouwer chain carries away the quenched coke and delivers it into reinforced-concrete hoppers, whence it is taken in cars to the coke works.



BROUWER RETORT-CHARGING MACHINE

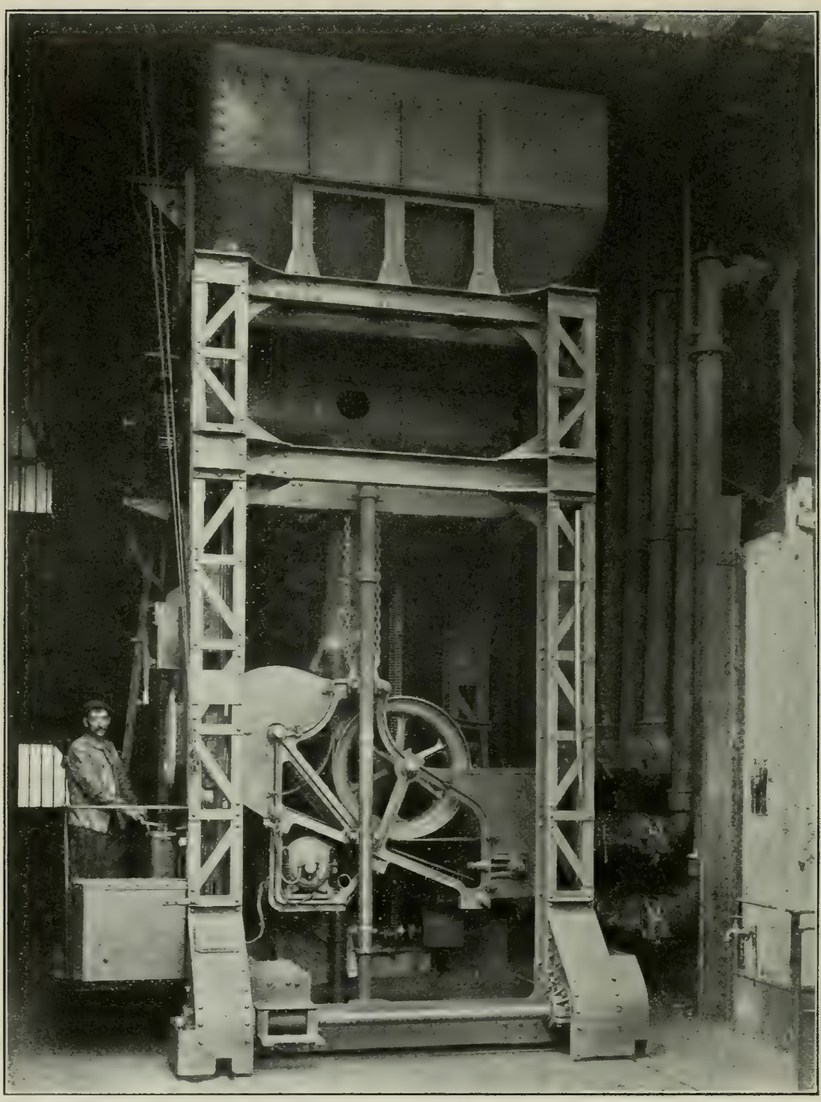
The principal part of the Brouwer charger is a groovel wheel (A, Figure 2), with a U-shaped rim; a leather belt engages one quarter of the circumference (R P), thus enclosing that portion of the hollow face of the wheel. Two strips bb, stitched along the edges, reinforce the borders of the belt. This endless belt C, passing first around the motor pulley B and thence around the driven pulley O, forms a U-shaped artificial canal around a quarter circumference of the charging wheel A. When this wheel is given a sufficient speed of rotation, the centrifugal force acting upon the coal descending from the hopper T, as this coal passes from P to R of the U-shaped channel, gives it a motion which is supplemented by the travel of the belt from R to V, from which point the coal is left to travel tangentially into the retort W. Applying the laws of ballistics, it will be seen that the stream of coal reaching the end of the retort will spread and the successive layers will take the position shown by the lines i j, i^1 j^1. Experience proves that as the charging of the retort is finished the front of the coal follows the profile I J, and as the space J J is left entirely free



ELECTRICALLY OPERATED RETORT-CHARGING AND DISCHARGING MACHINES.

from coal dust, the retort may be hermetically sealed by merely closing the plug.

The operating parts of the Brouwer charger are mounted between two standards of a thoroughly braced and well-poised steel structure. A starting rheostat in front of the operator controls the electric motor driving the charging machinery, stepped resistances giving the



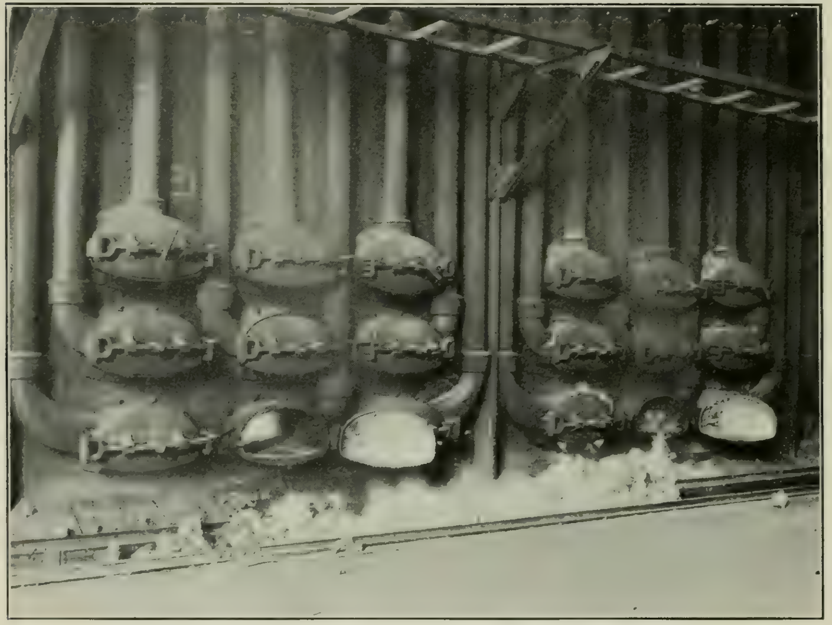
AUTOMATIC CHARGING MACHINE FOR THE RETORTS.

necessary speed variations. The electrical features are designed in view of the weight and character of coal to be handled. The idler and driven pulleys run loose on hollow shafts, keyed to the framework of the charger, with internal lubrication; entrance of dust between the moving surfaces is thus avoided and the wear thereby reduced. A feed hopper fixed on the structure of the machine itself carries a charge sufficient for nine retorts. At the foot of this feed hopper is a screw delivering the coal to the concave pulley. The number of turns of this screw, which is driven by an independent motor, determines the weight of each charge. The entire mechanism is supported on a rolling carriage moving along two rails parallel to the front of the retorts. For recoaling, the charger is run under one of the storage towers placed at the end of each of the battery furnaces.

When distillation is finished, the retorts are opened at both ends and the Sautter-Harlé discharger enters upon the scene. By the aid of a long ram, operated by rack and pinion (see page 935), the machine forces out the mass of coke in the retort, which falls, broken into pieces, onto a Brouwer conveyor at the other end.

The discharging ram is telescopic, consisting of three sections, and carries a flat head of section slightly less than that of the retort. Movement of the ram, and also the transverse movement of the whole machine, is effected by an electric motor of 12 horse power at 900 revolutions. The operator, standing on the rear platform, controls the transverse movement of the entire machine, the raising and lowering of the ram, and its movement of thrust and withdrawal. The first lever acts upon a friction coupling, which, through the intermediary of a worm-gearing, drives one of the axles of the machine. The charger moves to the right or to the left as the friction is thrown in on one side or the other. Raising and lowering of the ram is controlled by a lever acting upon another friction clutch, which engages one of the four vertical screws shown in the illustration, upon which the ram is supported by bronze nuts. The four screws are connected by a chain running over sprockets at the top so that they move in common, and the casing supporting the ram is lifted or lowered according as the driving screws revolve one way or another. The telescope movement of the ram itself follows the control of a friction cone driving a worm-gear, which revolves a slotted vertical shaft carried by the framework of the machine. To this shaft is keyed one of a pair of bevel gears, the mate to which, through a second pair of bevel gears, drives the five pinions which mesh with the rack of the ram. The pushing ram is in three sections, which come into play successively beginning with the innermost. This carries on its front end a piston, which drives the red-hot coke out of the retort.

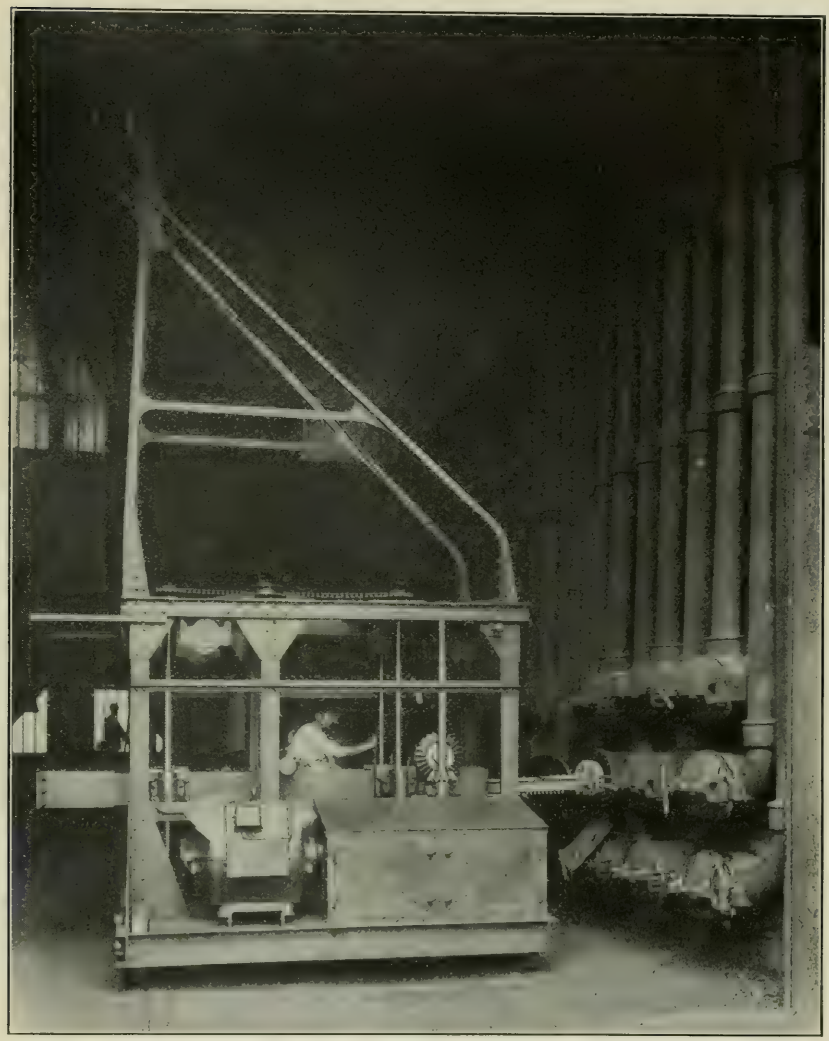
The entire Sautter-Harlé discharger occupies a space of but 3.7 metres in width across the front of the furnaces. Its operation is entirely comfortable, since the mechanician is sheltered from the heat of the retorts and performs no labor beyond the manipulation of the levers. After throwing the clutch lever he presses one of the buttons at his right hand. The racks and pinions engage, stop at the end of the run, reverse, and stop again without any intervention on his part except a simple pressure on the discharging button. The movement of elevation and transfer is accomplished the same way, while a safety switch secures absolute stop.



MECHANICAL EMPTYING OF RETORTS. DISCHARGE END.

In the table below are presented a number of figures illustrating in detail the operations of the electric dischargers at the Landy works. The retorts are 6 metres in length, carrying a charge of 600 kilogrammes and requiring 8 hours for distillation. The operation of emptying the retort, including the placing of the machine, takes in the average 55 seconds; in other words, each discharger can empty about 65 retorts per hour. The speed per second of the various movements and the current consumption at 240 volts are as follows:

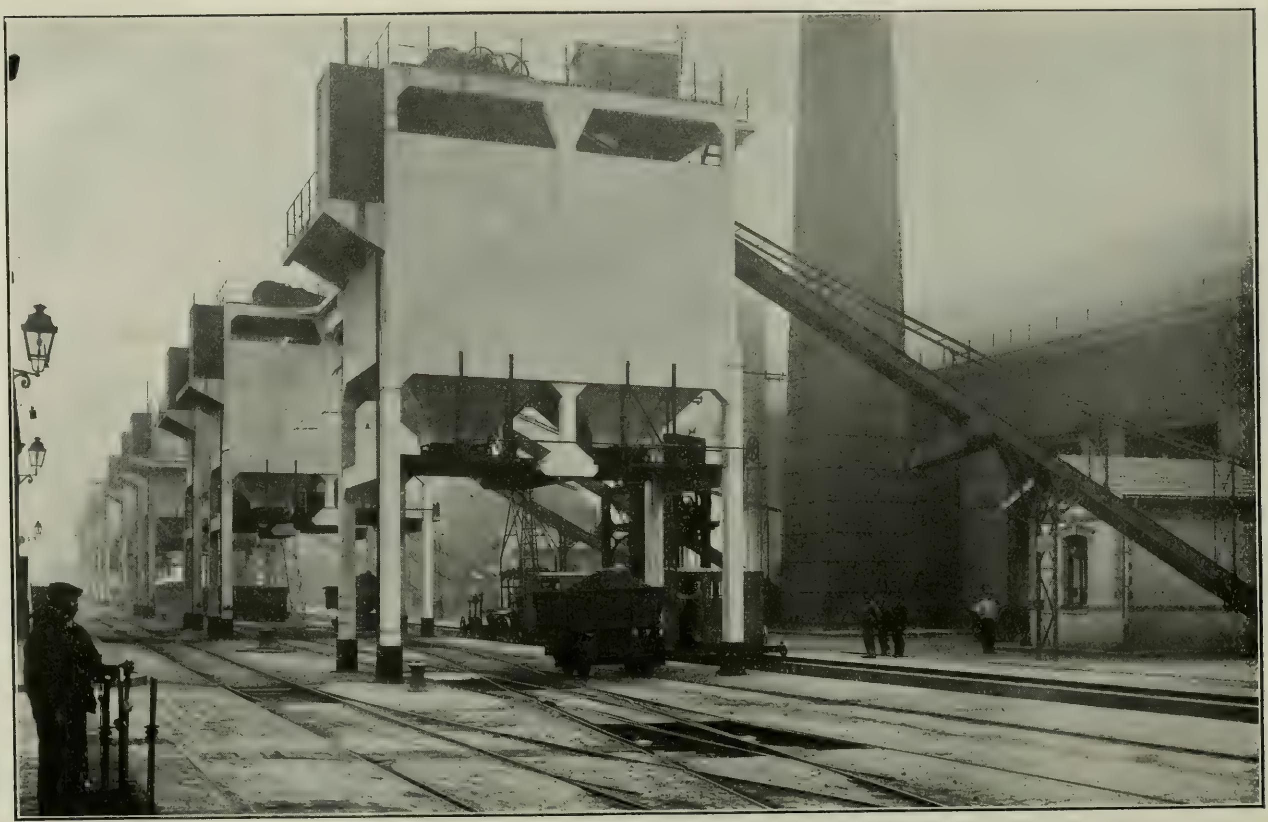
Operation.	Metres.	Kilowatts.
Discharging by the ram	0.36	1.80
Return of the ram	0.46	1.08
Raising the ram	0.22	1.80
Lowering the ram	0.23	0.72
Shifting the machine	0.60	1.20



SAUTTER-HARLÉ AUTOMATIC RETORT-DISCHARGING MACHINE.

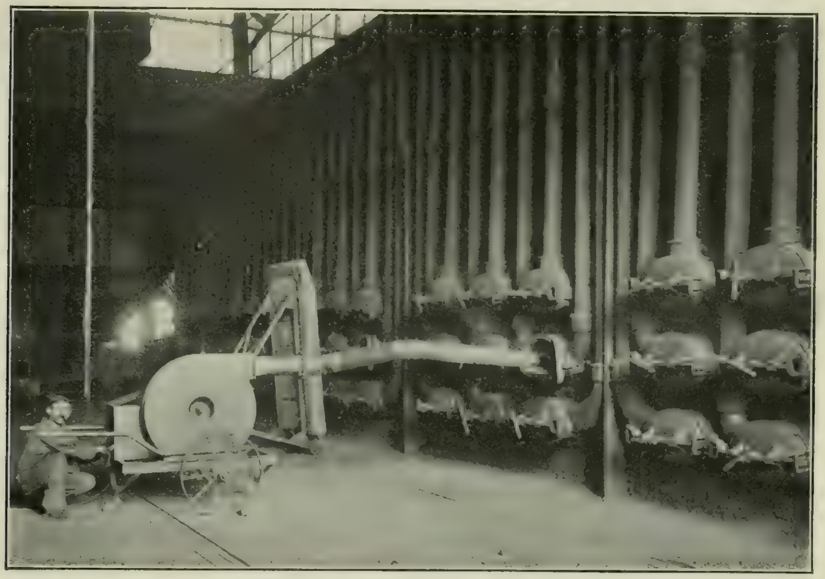
Diagrams secured by the aid of the registering apparatus show that the total consumption of energy under ordinary operation per retort discharged is only about 17 to 20 watt hours. Allowing 25 for errors of movement and for contingencies, it may be calculated that one kilowatt hour will suffice for 40 retorts containing 17 tons of coke, and yielding 7,200 cubic metres of gas approximately.

At the other end of the retort battery when machine discharging



AUTOMATIC COKE ELEVATORS FILLING THE TOWERS FROM WHICH CARS ARE LOADED BY GRAVITY DISCHARGE.

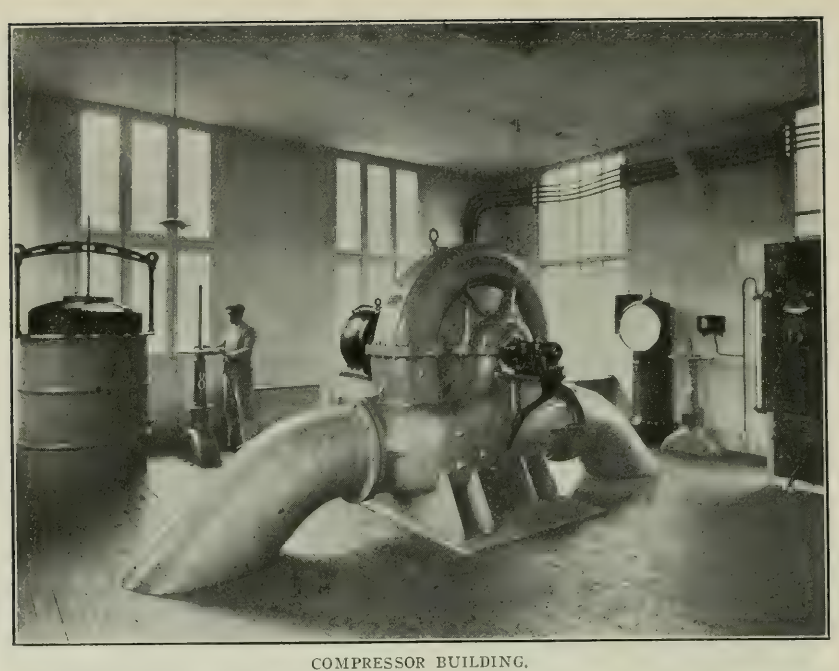
is going on there appears for several minutes a river of fire, of which the photograph gives a very faint idea. During this period the Brouwer conveyor carries the incandescent coke out of the building. At its exit, the coke is quenched by passing through a tank full of water, from which the resultant vapor escapes through large chimneys. Furthermore, the remaining jets of gas and of smoke are harmless, as the distilling house is deserted at the time of discharge. The only manual operations necessary are to open and close the heads of the retorts and sometimes to open with a sort of iron bar the riser through which the gas escapes. When the distillation is finished a workman also brings up a portable fan, which blows in a jet of air to burn up the graphite remaining in the retorts.



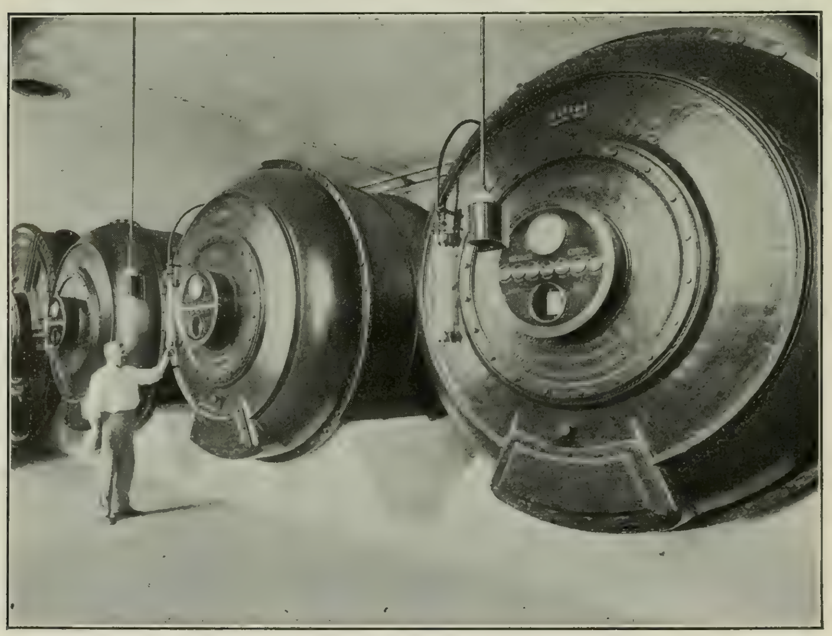
BLOWER FOR BURNING OUT GRAPHITE.

The quenched coke is carried automatically by a mechanical transporter to reinforced-concrete hoppers outside the buildings, from which it is later drawn into wagons for removal to other works. The various handling appliances (Brouwer endless chains and Sautter-Harlé elevators and transporters) are likewise electric-driven.

The gas generated in the retorts passes to the hydraulic mains. The old batteries of the No. 1 works had two independent mains, one at each side, while those of the No. 2 works more recently constructed have but one, placed over the middle of the furnace with two standpipes from opposite ends of each retort. These two sections have old-

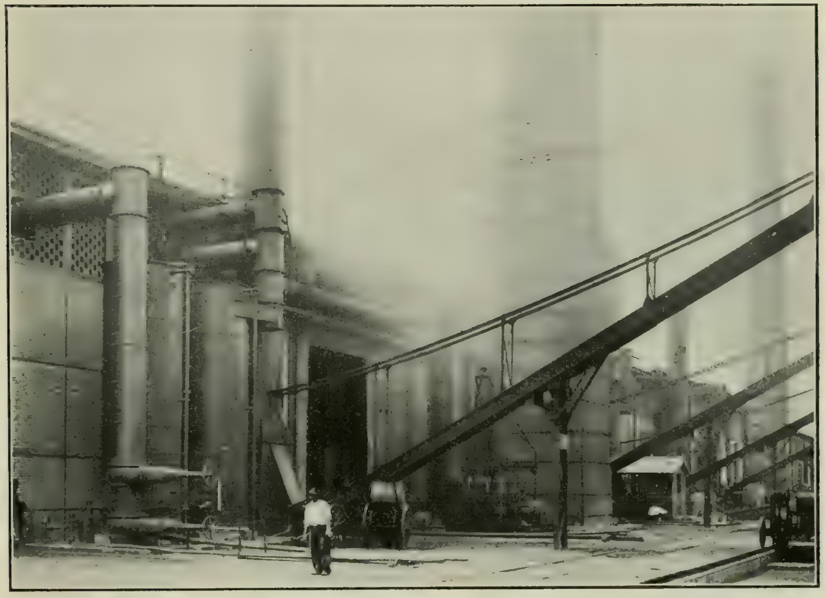


COMPRESSOR BUILDING.



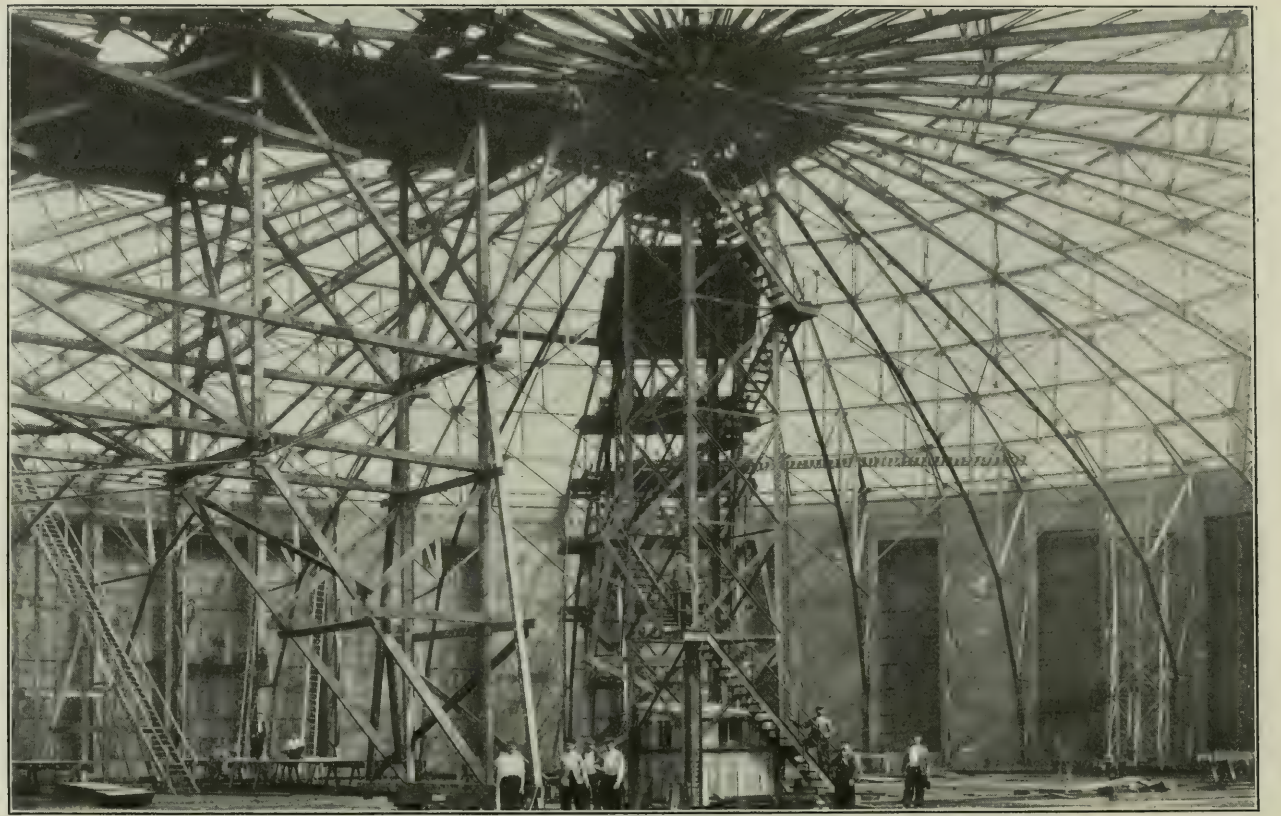
NEW GAS METERS, 60,000 CUBIC METRES CAPACITY.

style condensers, but at the No. 3 and No. 4 works, completed in October, 1910, two water-cooled tubular condensers for each battery have been installed close to the furnaces. After passing the condensers the gas passes through the usual exhausters, through the purifiers, to the gasometers. There are now in service in the two distilling plants in ordinary operation three piston exhaust pumps (two of 8,500 cubic metres, and one of 65,000 cubic metres capacity, and two Beale exhausters of 120,000 cubic metres capacity. They maintain a pressure of less than 1 centimetre of water in the hydraulic main. Four additional Beale extractors of 120,000 cubic metres capacity are installed in another building to pump the gas generated in the two new works in the course of construction.



NEW REFRIGERATING APPARATUS, REPLACING THE OLD CONDENSERS.

Without following further the processes of purification, we may note that the by-products are sent to La Villette for treatment, while the gas passes through thirteen meters, four of old model, 40,000 cubic metres per 24 hours each, and nine of the new Duplex model of 60,000 cubic metres each, place being left for installation of a tenth meter. All are arranged to operate in parallel. Beyond the meters are the gasometers. When the works is in full operation, there will be eight —five old-style simple bell gasholders, each of 30,000 cubic metres capacity, and three new style, three-lift, telescopic, each 150,000 cubic



A 150,000 CUBIC METRE GASOMETER UNDER CONSTRUCTION AT THE LANDY WORKS.

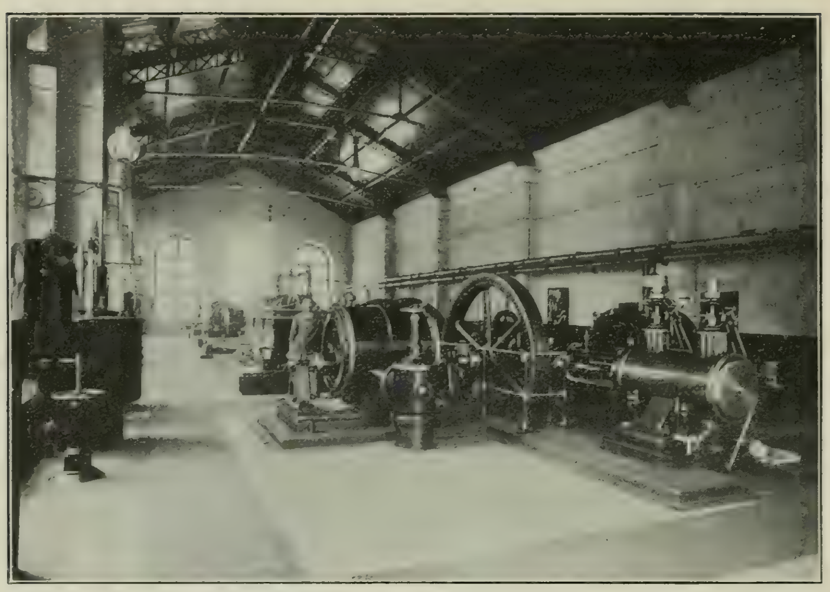
metres capacity, giving a total capacity of 600,000 cubic metres. The illustration on page 940 shows one of the new telescopic metres in course of construction; its shell resembles a vast circus 70 metres in diameter and is made of plates 39 millimetres thick. Telescopic holders will ultimately replace the old ones.

The distribution of the gas at Landy may be under the gasometer pressure only, or under a higher pressure obtained by three Rateau compressors coupled to electric motors. In addition to this, two pressure regulators with suitable valves and piping and many pressure gauges complete the distributing plant.

The compressors take the gas from the several gasometers of the Landy works and deliver it through a main conduit, one metre in diameter, to the station at Le Chatelier, where the distributing systems from the various works come together. The compressors are designed to reinforce the pressure at Le Chatelier, according to the requirements of the consumption; they are arranged to deliver a variable duty and pressure according to the indications constantly received at Landy from Le Chatelier. The discharge of the compressors is also connected with the works at La Villette so as to enable utilization of the reserve storage capacity at this latter plant for part of the gas made at Landy. It will shortly be conneced, also, wih several other works (Concorde, Clichy, Montmartre) which will operate in the same way as Le Chatelier.

Each compressor can deliver approximately 23,000 cubic metres of gas an hour at a pressure of 900 millimetres of water. They are of Rateau centrifugal type, operated directly by electric motors through elastic couplings. Each motor can develop about 140 horse power; they were specially designed at the Thomson-Houston works for the high speeds at which they must operate. The speed variations are wide and are obtained by a hand-operated rheostat.

Our review may be closed by a brief note of the central station supplying light and power for the apparatus at the Landy works. The steam plant contains eight Niclausse boilers, each evaporating 2,500 to 3,000 kilogrammes of steam an hour, at a pressure of 12 kilogrammes and a temperature of 275 degrees. They have double fire boxes automatically stoked and cleaned. They are fired with coke breeze. In two rooms symmetrically placed behind the boiler-plant are two electric generating groups, each consisting of a tandem-compound steam engine of 650 horse power, and a compound-wound dynamo of 400 kilowatts at 250 volts. The engine may be operated either non-condensing or condensing. Jet condensers and air pumps



THE EXHAUST PUMP ROOM.

are installed beneath. In each one of these stations there is a booster for a storage battery placed in a neighboring reinforced-concrete building, which houses also a water-purifying installation and a refrigerating plant.

In brief, the Landy gas works, with their remarkable mechanical handling plant, their ingenious apparatus for charging and discharging retorts, their improved furnaces, and their gigantic gasometers, are the last word in this field of technologic progress. This huge enterprise does honor to the engineers of the Société du Gaz de Paris, who have been equally solicitous for upholding their scientific reputation and for ameliorating the condition of the workers placed under their command.

THE TWELVE PRINCIPLES OF EFFICIENCY.

By Harrington Emerson.

X. THE EIGHTH PRINCIPLE: STANDARDS AND SCHEDULES.

> The bird is nearly a thousand times as heavy as the air its bulk displaces, but how inimitable is the work—for the way of a bird in the air remains as wonderful to us as it was to Solomon. As a child I watched a hawk soaring far up in the blue sky and sailing for a long time without any motion of its wings as though it needed no work to sustain it, but it was kept there by some miracle. I saw it sweep in a few seconds in its leisurely flight over a distance that to me was encumbered with every sort of obstacle which did not exist for it. The wall over which I had climbed, the ravine I had crossed, the patch of undergrowth through which I had pushed, all these were nothing to the bird, and while the road had only taken me in one direction, the bird's highway led everywhere and opened into every nook and corner. How wonderfully easy was its flight. There was not a flutter of its pinions as it swept over the fields in a motion that seemed as effortless as that of its shadow!—LANGLEY.

HUMMING birds winter in Central America and nest in summer in Alaska, yet bring up families as beautiful, as courageous and as achieving as themselves. The stormy petrel flies four hundred miles through the fog and strikes its burrow exactly, storks marked in Norway have been caught in South Africa, curlew and plover are supposed to fly at the rate of four miles a minute.

The barn-yard fowl, if frightened, runs and flutters over a low fence, and panting with exhaustion is soon run down. The rooster uses his wings to flap when he crows, the hen uses hers to brood her chicks, their ancestors having forgotten that they were birds and that the limitless air was their inheritance.

"Who ever heard of a woman tiring when she was having a good time, even if she had danced all night!" said Nietzsche, and the police in San Francisco on March 20, 1910, on advice of doctors present, stopped a dance after six of the contestants had been dancing 15 hours and 6 minutes.

Prof. Wm. James pointed out and insisted on the second wind, the ability that comes after first fatigue, after the barn-yard flutter, to endure and achieve, to fly!

Standards and Schedules! These are of two kinds, the physical and chemical standards discovered and established in the last century, standards and schedules as exact as mathematics, and those other schedules resting on standards whose upper limit we do not yet know. We have our five senses. We can taste or smell an infinitesimal taint in food, we can smell the millionth part of a grain of musk, we can discern by touch the ten-thousandth part of an inch, a man heard 2,390 miles away the boom of the explosion of Krakatoa, we see billions and billions of miles distant a new star bursting into brilliance; but there is a region not ten miles away about which we know less than we know of the nebulæ, because we cannot reach it with our senses, nor yet with our physics and mathematics—a region ten miles or less straight down under foot.

By bringing into play our instruments, our bolometers which measure the millionth of a degree of heat, our ultra-microscope which almost enables us to see the atoms, one one-millionth of a second measured on the tracing of a tuning fork's vibrations—by the refinements of physics and chemistry we can peer into the true inwardness of material things; so we use stop watches for time and motion studies of our machines; but when we wish to schedule work for sentient beings, then our mathematics fail and we fall back on experiments inspired by faith. Four miles a minute the flight of a little bird, 99 per cent and more the efficiency of the fire-fly's light, the sixth sense of the blinded bat, the sudden stop of the grizzly bear from full trot in darkest night when he was within a foot of the finest flower wire leading to a flash-light camera!

All around us, everywhere nature has been showing us that increased result comes from lessened effort, not from greater effort, but we have been too stupid to understand. Because it takes one pound of coal to produce one horse power, and two pounds of coal to produce two horse power, because it is harder to jump over a fence four feet high than over a fence two feet high, because it is still harder to jump over a fence five feet high, we have non-reasoned back from results to effort, and concluded that effort should be gauged by result which is in accord with one set of experiences but wholly contrary to the larger experience. Any specific kind of effort, measured by results, falls from a maximum to a minimum and then rises again to another maximum, so that there is only one point where maximum result is attained for minimum effort, a point properly scheduled at 100 per cent.

As to specific result it may be attained in many ways. Tame geese in Germany are slowly driven to market in September, waddling a few miles each day. They are prepared for the trip by walking through soft warm tar and then through fine gravel and sand, so that, thus shod, their feet may stand the weary march. Wild geese fly from Golofnin Bay, Alaska, to the tropics in less time than the tame geese waddle a hundred miles. The wild goose's distance and time schedule would be ridiculous for the tame goose, the latter's schedule an absurdity not less cruel for the wild geese.

As to the variation in effort for similar conditions, we have but to remember that while it is pleasant to spend from six to twelve hours in bed, it is an affliction to spend all one's time in bed, a greater affliction than to have no bed and to snatch rest as one can on a long tramp or journey, for men can sleep even when walking. It is easy to walk three or four miles an hour; it is intensely wearying to stand waiting or to walk two miles an hour, when shopping with one's wife—more wearying than the five-mile an hour trot of the Yukon winter trail. It is easy to ride a bicycle 10 to 15 miles an hour, it is desperately hard to ride 1 mile an hour or 20 miles an hour, and either endeavor will send the rider exhausted to bed. How much more exhausting it is to breathe either fast or slow than to breathe naturally, the latter being absolutely effortless and kept up from birth to death, waking or sleeping. Natural breathing, natural heart beats, natural temperature, are 100 per cent efficiency.

This law of the reduction of effort for greater results crops up in the most unexpected places, so that engineers have evolved the definite critical speed, the speed of maximum result for relatively least expenditure.

In fast steamers resistance does not increase with the cube of the speed, but there are certain higher critical speeds at which resistance is less. Nearly 100 years ago in England a man running express passenger canal boats had them towed by galloping horses at a speed of nearly 14 miles an hour, claiming this was easier than a slower speed. He was ridiculed by scientists who opposed the law of cubic increase of resistance. A bet was made, dynamometers attached, and up to 8 miles the law held good; but above 8 miles the canal boat began to climb out of the water, so that at 14 miles the actual resistance was small. This was the origin of the hydroplane boat. A wise Kansas mare hitched to a plow, if it pulled heavily, would look back, take in the situation, and increase her speed. The plow immediately pulled easier because the greater speed flung the clinging earth free of the mold board, thus greatly lessening friction.

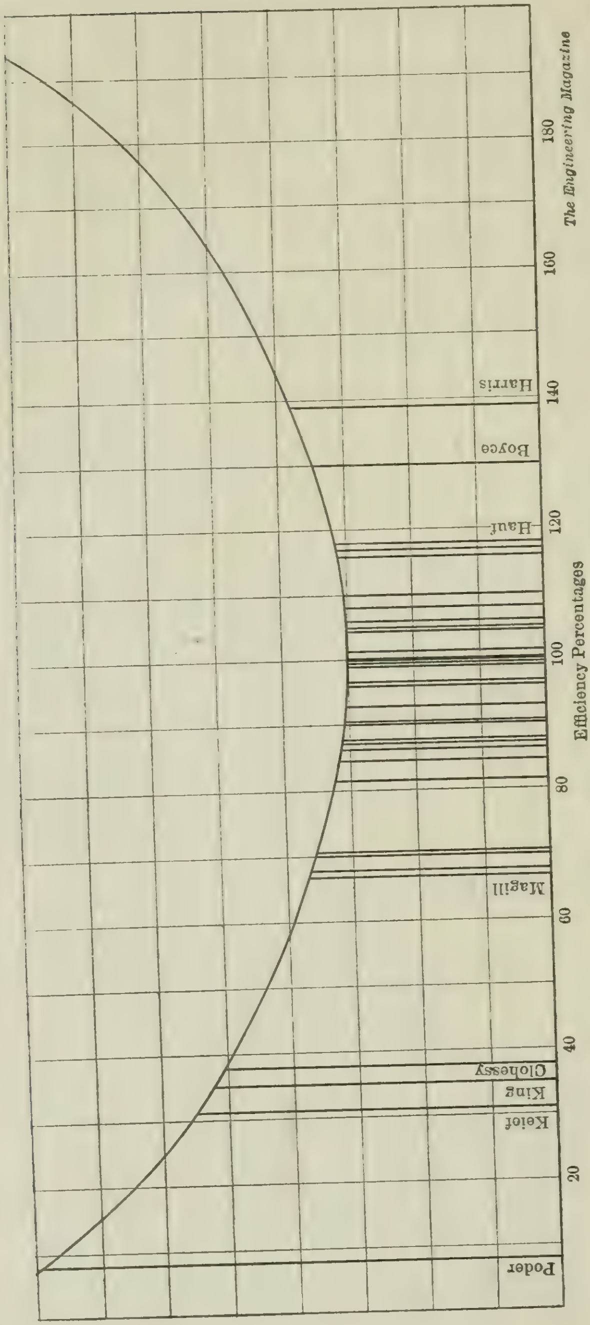


FIG. 1. TYPICAL MAN-EFFICIENCY DIAGRAM.

Time and motion studies having been made as to all the work of a gang of men, both conditions and operations were standardized and an efficiency reward was offered. The results are shown in the diagram (Figure 1). Nearly all the men are grouped between 80 per cent and 120 per cent, with the greatest density around 100 per cent—the region of least effort. The hardest worked man both psychically per unit of time and physically per unit of result, was Poder with an efficiency of 7.8 per cent. He was more exhausted at the month's end than Harris, who attained

139.2 per cent; Keief, King, and Clohessy were more tired at the day's end than Boyce and Hauf; Magill was as tired as Hauf.

A casual observation of the passengers leaving the Atlantic Highland boats at the Rector Street pier in New York on a Monday morning in summer, shows conclusively that in the crowd, some (a very few) travel over the long gallery from boat to street at the rate of 6 miles an hour; others, quite a bunch, at the rate of 4 miles; but the great body travels at the rate of 3 miles, and there are stragglers, mothers with little children, old ladies of social weight, also lingering lovers, who travel at rates shrinking to 2 miles an hour. The able-bodied, in so far as not hindered, have an average rate of 4 miles; and from these observations of voluntary effort, we can well establish a walking standard of 4 miles an hour with disapprobation if the rate falls below 3 miles, with special reward to those who reach and pass the 4-mile mark. Had we diagrammed these walkers on the pier, they would have given us a picture similar to the machine-shop curve of Poder to Harris. Both diagram and description show that the increase of effort between 100 per cent and 140 per cent is very slight—only 25 per cent, quite within the limit of normal variation above the rational average; and it also shows how possible it is for a good man to deliver nearly twenty times as much as the competent man, four times as much as the laggards, twice as much as the haphazard workers. Poder, Keief, King and Clohessy could never become Hauf, Boyce, and Harris. Piece rates based on the performance of Harris would be as ridiculous for Poder as wild-geese schedules imposed on tame geese fattening for Michelmas; but, without injustice to Keief, King, and Clohessy, the natural Haufs, Boyces, and the Harris clan can be selected for their natural work and be correspondingly rewarded.

There are places where Poder and Clohessy would fit, even as the tame goose, plucked for its feathers and prepared for the feast, shows 100 per cent efficiency, and the thin, stringy wild goose is far below par. The schedule must fit the man and the man the schedule; there is no such thing as a definite universal schedule. At best there is a broad schedule band (in the diagram, the region between 80 per cent and 120 per cent) and the records will show clearly whether the men have been selected to fit the schedule and whether the schedule fits the man. Irrespective of any current wage rate, a shop cannot be filled with the Hauf to Harris thoroughbreds for the wages that will attract the Poders and Clohessys.

If all conditions were absolutely standardized, if all operations

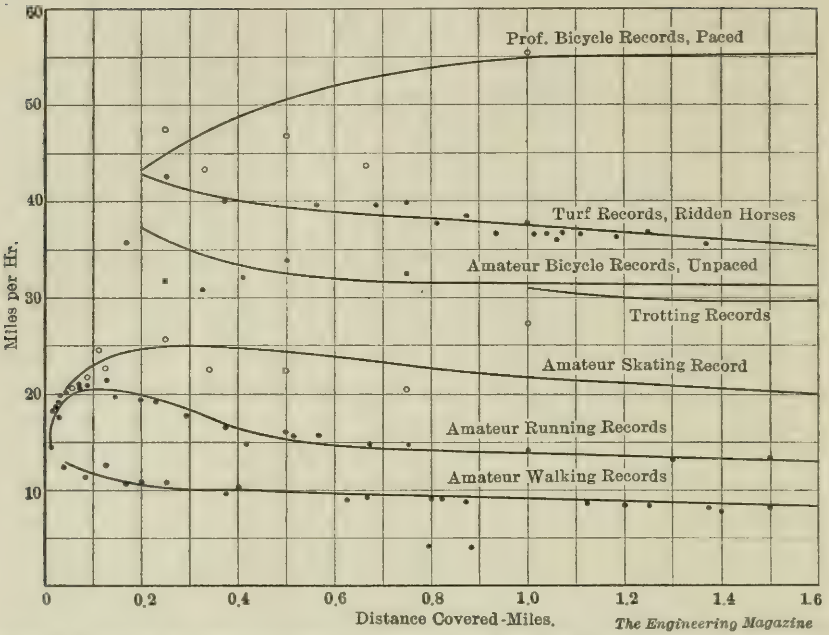


FIG. 2. DIAGRAM SHOWING SPEEDS IN MILES PER HOUR FOR BEST ATHLETIC RECORDS.

were also perfectly standardized, piece rates might apply with reasonable equity and fairness to the tame geese traveling the same road in the same weather with the same tar-sand shoes; but what about the wild geese far overhead? They must have schedules based on other standards.

In Figure 2 the speeds per hour for the best athletic records from start up to 100 miles show the time relations between different methods for the same distance.

TABLE OF ATHLETIC RECORDS.

	ONE MILE.		ONE HUNDRED MILES.		
	Actual speed	Relative speed	Actual speed	Relative speed	Relative to one mile
Amateur walking..........	9.2	100	4.8	100	52
Amateur running..........	14.	152	5.6	117	40
Amateur skating..........	21.8	237	14.	292	64
Amateur bicycle unpaced..	31.4	341	20.2	421	64
Professional bicycle paced.	55.3	601	35.5	740	64

It is known that each of these men put forth his best efforts, and assuming the men to be equal in strength, endurance, skill, we become certain that the mere addition of skates to the shoes increased

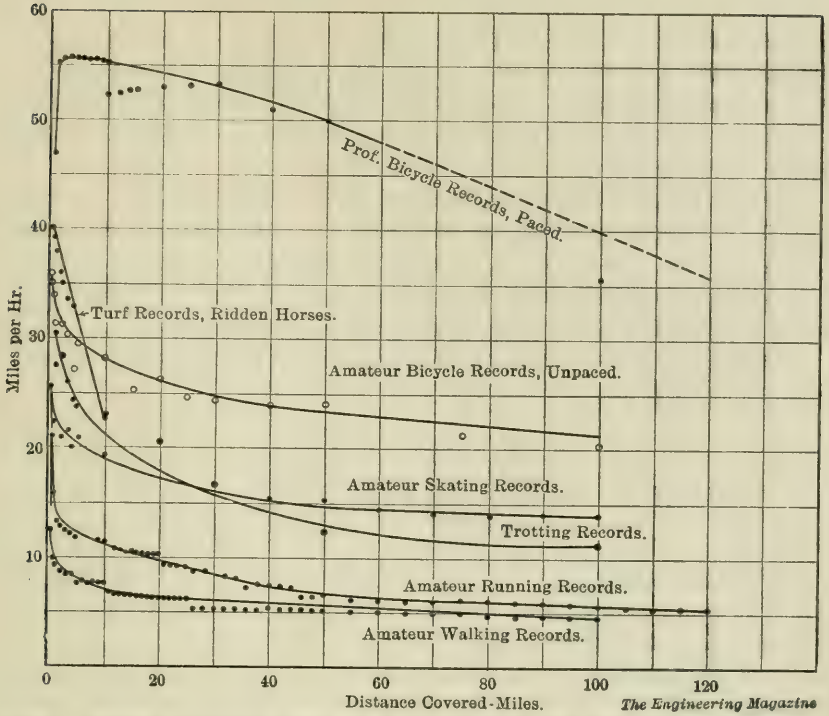


FIG. 2. DIAGRAM SHOWING SPEEDS IN MILES PER HOUR FOR BEST ATHLETIC RECORDS.

the speed for the same effort 2.37 times at one mile and 2.92 times at 100 miles; that the substitution of a bicycle for skates increases the speed 3.4 times at one mile, 4.2 times at 100 miles; and that the addition of a helping pacer, who in no way touches the rider, merely shielding him from the wind, increases the speed above walking sixfold at one mile, 7.4 times at 100 miles. All these records are of abnormal, excessive, and extreme speeds, but who can doubt that the relation would remain the same if they were halved, thus brought down to high normal—4.6 miles for walking, 28 miles for paced bicycle?

The time may come when aeroplanes rising on the wind as do the birds will glide on upward currents, as also do the birds, at a rate of two miles a minute for a thousand miles, or twenty-five times as fast as the walker, yet exert no muscular effort, using delicate instruments to feel the wind, and intelligence to guide the flyer.

Other facts appear from the table and diagram. For the 100-mile stretch compared to the one-mile stretch, both bicycle and skating fall to only 64 per cent of the speed, but walking and running collapse respectively to 52 and to 40 per cent, so the man-used and man-driven tools not only vastly increase the speed, but maintain it at a far higher proportion. At one mile the paced bicycle rider is only six times as fast as the walker, at 100 miles he is nearly seven and a half times as fast.

It also appears that the trotting horse, who begins faster than the skater, is distanced by him at 24 miles, and after that steadily falls behind. The horse does not have the man's courage. The man helped only by his bicycle is throughout faster than the trotter, faster than the running horse after the third mile.

For physical, for chemical, and for electrical relations we can set absolute standards:

$$1 \text{ horse power} = \begin{cases} \text{746 watts.} \\ \text{33,000 foot-pounds per minute} \\ \text{2,545 heat units per hour} \\ \text{0.175 pound carbon oxidized per hour} \\ \text{2.64 pounds of water evaporated per hour} \end{cases}$$

Practical standards are very different—one pound of coal in steam engines per horse-power hour, 10 pounds of water evaporated per pound of coal instead of 15!

For physical standards we can measure the extent of the shortcomings and diligently strive to lessen the losses; but in making standards and schedules for man we must first classify our men, and then we must so equip them that they can as easily do six times, seven times—yes, perhaps 100 times as much.

Walking 9.2 miles an hour is as to normal walking 200 per cent efficient, not a normal standard for any regular work, but compared to the effortless glide of the aeroplane it is only 10 per cent efficient.

To establish rational work standards for men requires indeed motion and time studies of all operations, but it requires in addition all the skill of the planning manager, all the skill of the physician, of the humanitarian, of the physiologist, of the psychologist; it requires infinite knowledge, directed, guided and restrained by hope, faith and compassion.

The promise already partly fulfilled and clearly held out as to the future is that greater and greater results shall follow constantly diminishing effort.:

EDITORIAL COMMENT

Railroads and Prosperity.

IN refusing the advances in rates which the railroads of the United States have sought to impose, the Interstate Commerce Commission has taken a stand that may prove to be a turning point in the progressive exploitation of the public by "The Interests"—an exploitation heretofore almost unchecked, because resistance to it, though growing in bitterness, has lacked organization and has lacked efficient mode of expression. At the expense of momentary, but passing, consternation, the Commission has perhaps stayed a worse thing—a thing that could scarcely be defined without incurring the charge of being an alarmist.

The decision written by Commissioner Prouty outlines the conditions underlying this exploitation in a clean-cut paragraph calling attention to the interrelationship between the directorates of the railways and those of the corporations from which the railways purchase their principal supplies. The testimony of a railroad vice-president is cited to show that in the supply of locomotives, of rails, of steel structural shapes, of cars, there is no competition, but a limitation of railroad orders to two, or at best less than half a dozen, concerns. The decision goes on to say:

> Now, if the steel trust is to determine the price which shall be paid for rails and for bridges, if the locomotive trust is to determine the price of engines, the car trust of cars and the labor trust of labor, and if the railways have only to meet the demands made by these combinations and charge over to the public by an increase of rates whatever is paid, a most unfortunate situation has developed.

Most unfortunate, indeed. To realize how unfortunate we must go further even than the alarming status thus defined and look into the future as it shows itself to the officials of the railways asking the present increase. In the early part of the hearings leading up to the decision just announced, Commissioner Lane inquired of President Willard, of the Baltimore and Ohio: "Is there any reason to believe that these increases (of rates) would stop with the present increase if it should be allowed?" President Willard replied: "No, I think not. I think the tendency of rates will be to continue upward." When the Commissioner pushed the interrogation further, saying: "You think there will have to be a progressive increase?" President Willard's answer was: "Yes, sir." In the language of Mr. Brandeis's brief, actively indeed should the consumer "beware of this vicious cycle of ever-increasing freight rates and ever-increasing cost of living." Building on such a foundation, the whole structure of railway prosperity and national welfare is hopelessly wrong in plan and theory, growing to certain ruin. Yet the policy had been so long pursued, so long supported by financial duplicity, by specious argument to the ignorant and terrorism over the timid, that the way back to industrial health seemed hopeless.

The Commission did not find it necessary to go beyond the railways' own case to support their finding. This finding is that neither the credit nor the physical efficiency of American railways is impaired or is in the least danger of impairment. It may be well to remind any over-sympathetic or over-fearful person that no one except the railways themselves ever attacked or even doubted their financial soundness. Foreign investors and domestic purveyors have regarded them with absolute confidence—so regard them even yet, in spite of the industry with which the railways have disparaged their own financial prospects. The Commission finds good grounds for the faith of investors and railway-supply interests in the showing made by the official returns—a showing of continuous progress in strength and wealth for more than twenty years, with no recent or present check and nothing to suggest uncertainty of advance along the same course. From 1888 to 1910 the percentage of railway-stock paying dividends rose from 38.56 to 67.20, and the average rate paid on dividend-paying stocks increased from 5.38 to 7.47 per cent. During the same period the surplus carried on the books of American railway companies mounted from less than $200,000,000 to more than $800,000,000. And beyond this, again, is the enormous amount taken from current earnings and put into permanent betterments. There is nothing in these figures to support a plea for the necessity of added revenue. By no standards of necessary well-being or ordinary prosperity do the railways appear to need it. By no testimony proving rising expenditures, for supplies at least, was any such demand supported. On the contrary, the cost of materials was shown to be either stationary or declining. Only in the item of labor, and there only to a limited extent, was any increase of outlay demonstrated. If as to this item the railways want relief, want a still larger margin of profit, they may go into the shippers' case and find there, constructively set forth, clearly defined ways and means for increasing net revenues without increasing rates or decreasing wages or employment.

That remarkable body of testimony setting forth the principles and results of efficiency methods—of the scientific management contributing to efficiency—which was greeted by the railways first with ridicule and then with hostility, may at length prove their salvation. We are glad to announce that it is to be made available in permanent form. The portion of Mr. Brandeis's brief presenting the case for efficiency is being issued in book form by THE ENGINEERING MAGAZINE under the title "Scientific Management and Railroads." This is put forth by the voluntary act and effective co-operation of Mr. Brandeis, not as a commercial enterprise, but as the continuation of a public service.

Science Versus "Systems."

IN view of the hasty, imperfectly informed, and not very wise propagandism of efficiency (or "scientific management") undertaken by magazines of general literature, it becomes a duty to those who, like ourselves, have been furthering the movement for more than a dozen years, now to preach caution where heretofore we have had to preach courage.

More than ten years ago, we declared editorially our recognition of the "science that forms the foundation of intelligent advance in the economy of production—a specialized branch of engineering effort—production or industrial engineering." To the ideals directing the application of this science, we later gave the designation "the philosophy of efficiency," a philosophy so widely hopeful of betterment to all that we ventured to call it "a gospel." The terms as applied to great concepts have been since attached to very much smaller ones.

Efficient management is obtainable only by the guidance of a philosophy—by the application of a science. It is based upon principles, but not reducible to any single "system." A system, however skillful, is but a method of applying principles. Industrial managers at this juncture must beware of upspringing systematizers, uninstructed in the philosophy, science, or principles of efficiency, seeking to secure its form by the mechanical application of methods, but ignorant of its spirit and so missing its results.

REVIEWS-ADVANCED PRACTICE

NOTABLE ARTICLES OF THE MONTH IN THE SOCIETY PROCEEDINGS
AND TECHNICAL PRESS OF EUROPE AND AMERICA

THE OPTICAL DETERMINATION OF STRESSES.

THE ADVANTAGES, METHODS AND PRACTICAL APPLICATIONS OF OPTICAL STUDY OF STRESS DISTRIBUTION IN TRANSPARENT BODIES.

E. G. Coker—Engineering.

MANY of the structures which engineers are called upon to design, particularly those of a highly complex form, are subjected to loads which are not accurately known, and which in many cases can only be guessed at in our present state of knowledge. Take, for example, the cylinder of a large modern gas engine, with its numerous passages and ports for the inflow and outflow of hot gases and for cooling water for the jacket, and its flanges and other accessories rendered necessary for constructional purposes. This complicated structure is subjected to the high explosive pressures, to intense stresses due to the variable heating action of the hot gases, and to the cooling action of the jacket water, so that we have a combination of stresses produced in a comparatively fragile material by extreme variations of both pressure and temperature, which are not easy to determine, and, in fact, are not fully known at the present time. This is only one of many examples which might be quoted in which our knowledge of the actual conditions of loading and the state of stress produced is very deficient.

One kind of inquiry which appears to offer some scope for the elucidation of problems of this character is the determination of the conditions of stress in transparent bodies by the effects which these bodies, when subjected to such stresses, produce on polarized light passed through them. Prof. E. G. Coker, who discusses the principles and applications of this method of stress determination in *Engineering* for January 6, believes that for some special purposes transparent materials offer advantages to the investigator which are not possessed by any other material.

Prof. Coker introduces his subject with a review of the properties of light which are of importance in determining the stresses and strains in transparent bodies. We may suppose that light is due to a vibratory motion set up in an elastic medium, called the luminiferous ether, which fills all space, and that a ray of ordinary light is caused by displacements which are transverse to the direction of the beam, and have any azimuth. The velocity V of the ray depends on the transverse rigidity C of the medium and its density D, and is expressed by the relation $V = \sqrt{C/D}$. The interposition of bodies like glass retards the velocity of a ray; the retardation may be due to a change in either the rigidity or the density of the medium or in both properties. In a transparent body which has the same physical properties in all directions, changes in the ether will have the same effect on an ordinary ray of light passing through it, whatever the direction may be; if, however, the material is subjected to stress in any prescribed manner, the properties of the ether may alter and affect the properties of the ray in certain directions. Since the vibrations of the ether are taking place in all planes passing through the line of direction of the beam, such a change is not observable under ordinary circumstances; but if the vibrations are confined to one plane, the differences in the physical properties of the material, due to the applied stress, generally cause a break-up of the wave motion into two components, vibrating in directions at right angles, and moving with different velocities in the body.

This property of "double refraction" is possessed by many natural bodies having an ælotropic structure, and is due to the way in which the molecular constituents arrange themselves in certain definite directions, as in a crystal. It is well known that Iceland spar possesses this property. Double refraction may be produced artificially in various transparent bodies, notably glass, by the application of external forces, whereby the material becomes doubly refracting, and the interference effects between the two rays produce color bands, which are extremely delicate indications of the state of stress in the material. Taking a simple case of two sources of light emitting waves of one kind of vibration only, the effects of interference can, by suitable optical devices, be made visible to the eye by the production of dark and light bands, and these latter give a uniformly tinted field corresponding to the same kind of vibration as each source. If, however, we use white light, which is composed of waves of different lengths corresponding to the colors of the spectrum, the results of interference generally produce color effects ranging over the whole spectrum.

Materials which are naturally doubly refracting, or which are made so by the application of stress, have the power of decomposing a plane-polarized ray (a ray passing through a doubly refracting crystal, such as a crystal of Iceland spar, parallel to the "optical axis" of the crystal, which is not broken up into two rays, but which has its vibrations "polarized" into one plane) into components at right angles, which, on recombination by suitable apparatus, produce interference effects. Hence this distinctive property makes it possible to investigate the state of stress in the interior of a transparent body, if we have suitable optical apparatus for the production of a beam of polarized light. The most convenient apparatus is the well-known Nicol's prism, a modified form of crystal of Iceland spar. For the examination of specimens under stress it is convenient, for photographic purposes, to have a strong point source of light, such as that obtainable from an arc lamp, and to pass the beam through a large Nicol's prism, or an equivalent arrangement, to plane-polarize it. This beam is then transmitted through the specimen under stress, and the components of the two sets of rays produced are recombined by a second Nicol's prism, and the resulting interference effects projected on to a sheet of squared paper or a sensitive plate.

"If we pass a beam of plane-polarized light through a specimen of a transparent material, as, for instance, glass, we find that if the polarizing Nicol and the analyzing Nicol are set with their principal planes at right angles to produce a dark field, the interposition of a piece of glass makes no difference to the field of view, but that even a slight stress produces a color effect, and that for every variation in the intensity of a uniform stress a correspondingly uniform color is produced, provided the material remains elastic. A color scale may thus be formed which for pure tension or compression stress indicates its numerical value, and a relation between them may be readily established. For examining the behavior of a beam subjected to uniform bending moment, for instance, the actual stress in it may be determined by the color fringes produced by the interference of white light, or, probably with more accuracy, by using monochromatic light. As may be surmised, there is considerable difficulty in estimating the amount of stress from the color produced, and this is especially the case with colors like yellows and reds; but this difficulty may, to a great extent be removed by a process of matching colors. In order to do this the object under observation is arranged close to a uniformly stressed test piece, and the load applied to this latter is adjusted until the color effect produced corresponds to that at some point of the object where the stress is required."

Prof. Coker's paper is illustrated with eighteen reproductions by the three-color process from colored photographs taken on Lumière plates direct from specimens under stress. Two of these show the colors obtained in a beam of rectangular section, loaded with a uniform bending moment; they show that the stress varies almost directly as the distance from the neutral axis, the position of which is marked by a dark band at the centre. Four of the illustrations show interesting examples of the effects of semi-circular and V notches on the stress distribution in tension and compression members. Other subjects illustrated include a corrugated furnace flue section in tension, circular hooks and circular chain links, a locomotive plate spring, a square-headed screw and nut, a pillar with pin-jointed ends, and a trussed beam centrally loaded, and also with the load on one side of the central section. Prof. Coker demonstrates the applicability of this method to determine not only the nature of the stresses produced, but also their magnitudes, by taking a case in which the stresses may be independently calculated. He takes a tie bar loaded eccentrically by a definite amount, and shows that the measured stress effects agree very closely with the calculated values. In his opinion, this and other examples which might be quoted show a sufficiently close agreement with theoretical calculation to justify the application of optical methods to the study of problems for which no theoretical results are available.

"To apply this kind of experimental work to cases of practical importance, it is evidently desirable that the material used should possess similar physical characteristics to those possessed by steel, iron, and other materials in general use by engineers, and in this respect glass is probably superior to any other transparent material. Unfortunately, however, in order to produce the color effects in glass specimens, it is necessary that the material should be very thick, and the forces to which the glass is subjected very great—in fact, very near the breaking point of the material. Glass is, moreover, an extremely difficult material to shape, and specimens can only be produced by laborious processes.

"The extensive commercial use of xylonite and such-like preparations in recent years, however, affords a material which has nearly all the desirable features of glass, and, in addition, some other characteristics which make it superior to glass in many respects for this kind of experimental work. Xylonite is a preparation of nitro-cellulose, which may be obtained in large sheets of moderate thickness, entirely free from stress except at the edges. It is not usually made more than one-eighth inch thick, but as it is so much more compressible than glass, it is, generally, more convenient for use in these thin strips. The material is not quite so transparent as glass, and is usually slightly tinted; but it has the very important advantage that specimens may be cut from the sheet quite readily with ordinary wood and metal-working tools, and with reasonable care the contours of the specimen show no signs of residual stress after shaping."

Whatever be the shape of a plane lamina and the nature of the applied forces, the stresses at a point may be represented by two principal stresses at right angles, while the angular positions and magnitudes of these principal stresses will usually vary from point to point. If the plane of polarization coincides with one of these principal stress axes, the ray passes through unchanged, and therefore, with the polarizer and analyzer set with their principal planes at right angles to produce a dark field, we still obtain a dark field in the object wherever the direction of the principal axes of stress correspond with the principal planes of the Nicols. In determining the condition of stress by plane-polarized light in other than the simplest cases, this disturbance must be eliminated. Its elimination is effected by combining with each Nicol's prism a quarter-wave plate set with its axis inclined at 45 degrees, thereby converting the plane wave issuing from the first Nicol into a circularly polarized ray—that is, a ray of plane-polarized light in rapid rotation about its line of direction, which therefore presents the same aspect to every part of the stressed material.

"It has been mentioned above that at any point in a plane lamina, the state of stress can always be completely represented by two stresses at right angles; and if their directions and magnitudes are known over the whole specimen, the state of stress is completely determined. The optical method is particularly well adapted for the determination of direction of the lines of principal stress from the fact that plane-polarized light has a selective action, since it does not allow light to pass through the stressed specimen at any place where the principal planes of the Nicols are parallel to the planes of principal stress. For any arbitrary position of the crossed Nicols, therefore, we obtain a series of dark bands, which are the loci of these positions, and, by setting the crossed Nicols in new positions, we obtain other bands corresponding to new axes of principal stress."

By means of optical methods, "it is possible in most cases of complicated constructions, such as are met with in girders, trusses, rivetted joints, pillars, notched bars, and the like, to form some approximate idea of the distribution and magnitude of the stresses from models. . . . In addition to their value for experimental investigations, optical methods appear to have a certain amount of value for educational work. It is probably a very common experience that engineering students rarely show the same degree of enthusiasm for the study of the theory of elasticity as they do for the study of other branches of science, such as heat engines, for example. It is difficult to realize what is the internal condition of beams, shafts, and the like, when they are bent, twisted, or otherwise stressed; and the average student, especially if he comes direct from school, does not readily grasp the meanings of the symbols he uses, or the significance of the formulæ he obtains, because of lack of illustrations of the nature of internal stress. With a limited amount of experience it seems quite safe to say that the pictures which optical experiments present to the eye afford a measure of help to students, whether they are intelligent workmen or the more systematically trained students of an engineering college."

THE LICENSING OF CIVIL ENGINEERS.

AN ABSTRACT OF THE MODEL LAW DRAFTED BY A COMMITTEE OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

American Society of Civil Engineers.

STATE control of the practice of engineering is being so widely urged in the United States that the question has become one of the utmost importance to the engineering profession. Bills regulating the practice of engineering have been introduced in a number of state legislatures, and in a few instances these bills have become law. The agitation against the Raldiris Bill introduced last year in the legislature of the State of New York brought the question prominently before the American Society of Civil Engineers, and about a year ago the Board of Directors of that body declared it the duty of the American Society to use its influence to secure legislation not prejudicial to the engineering profession in any state in which the regulation of the practice of engineering is demanded. In pursuance of this policy the Board of Directors, at the annual meeting in January last, offered the law abstracted below as a model for state legislatures who deem the regulation of engineering advisable for the protection of the public. At the same time they express the opinion that no legislation of the kind is needed, the public being amply protected if they will employ only those engineers who have demonstrated their ability, and both this opinion and the draft of the model law were approved by a practically unanimous vote of the members of the Society.

Civil engineering is defined in the Act as the practice of any branch of the profession of engineering other than military. The branches of the profession specifically mentioned, without prejudice to the design and supervision of other public or private utilities or works which require experience and like technical knowledge, are the design and supervision of the construction of public or private utilities, such as railroads, bridges, highways, roads, canals, harbors, river improvements, lighthouses, irrigation works, water supplies, sanitary and drainage works, of works for the development, transmission and application of power, and of electrical, mechanical, mining, industrial, hydraulic, municipal, sanitary, structural and other works which require experience and the same technical knowledge as engineering schools of recognized reputation prescribe for graduation.

The Act provides for the appointment by the Governor of the State of a State Board of Engineering Examiners of nine members, each of whom shall hold office for six years, and three of whom shall retire every two years. Each member of the Board shall be a professional civil engineer at least 35 years of age, shall have had at least ten years' active practice, shall be of recognized standing in the profession and licensed under the Act, and shall have been a resident of the State for at least one year immediately preceding his appointment.

The Board shall admit to examination any candidate who pays the established fee, and submits evidence, verified by oath and satisfactory to the Board, that he is more than 21 years of age; is of good character; has been engaged actively in civil engineering work, as assistant or otherwise, for at least six years, and has had charge of engineering work for at least one year; or is a graduate from a school of engineering of recognized reputation, and has been engaged actively in civil engineering work, as assistant or otherwise, for at least four years, and has had charge of engineering work for at least one year.

Within one year after the Act goes into effect, the Board shall issue a license to any candidate making due application and paying the proper fee, who furnished evidence satisfactory to the Board that he is qualified for admission to examination under the provisions mentioned above and has practiced civil engineering for an additional period of not less than four years immediately preceding. After the expiration of one year, and in all other cases, the Board shall issue licenses only on examination. Examinations for licenses shall be held at such times and places as the Board may specify, and their scope and the manner in which they shall be conducted shall be wholly at the discretion of the Board. Successful candidates shall be given the Board's license to practice engineering, on payment of the proper fee. Unsuccessful candidates at a first examination may, at any time between six months and a year after, again present themselves for examination without additional fee.

The Board shall issue licenses to residents of other states, the licensing standards of which are approved by the Board, on presentation of satisfactory evidence that they are properly licensed in their home states; or to residents of states not so approved on the presentation of satisfactory evidence that they are qualified as specified above for candidates for examination, and have in addition practiced civil engineering for an additional period of not less than four years immediately preceding application. No unlicensed person shall qualify as an expert witness in any State or municipal court, and no map, plan or drawing required by law to be certified or approved by a civil engineer shall be accepted by State or municipal authority unless the certification shall be executed by a duly licensed person.

The Board shall have power at any time to inquire into the identity of any person claiming to be a licensed civil engineer. It may revoke the license of a practitioner and annul his registration, if he has been guilty of any fraud or deceit in his practice, or has been guilty of any fraud or deceit by which he was granted a license to practice, or has been convicted of crime. When charges are preferred, they shall be heard by a committee of six members of the Board. The accused shall be notified of the time and place of the hearing by personal service, if possible, or by publication, if the accused cannot be found. At the hearing the accused shall have the right to cross-examine witnesses, to produce witnesses in his defense, and to appear personally or by counsel. On the recommendation of two-thirds of the committee hearing the charges, the Board may, at its discretion, revoke and annul the registration of the accused.

Any unlicensed person practicing, or attempting to practice, civil engineering, or who shall use in connection with his name any designation tending to imply that he is a practitioner of civil engineering, and any person violating the provisions of this Act, shall be deemed guilty of a misdemeanor. Any person attempting to file as his own the license of another, giving false or forged testimony before the Board, practicing civil engineering under a false or assumed name, or falsely impersonating a practitioner of like or similar name, shall for each offense be punished by a fine of not less than $100 nor more than $500, or by imprisonment for three months, or by both fine and imprisonment.

The Act shall not apply to engineers working for the United States Government; nor to any engineer employed as an assistant to an engineer licensed to practice civil engineering; nor to any engineer coming from another state and employed by the State or any municipality, corporation, firm, or individual therein, until a sufficient time shall have elapsed to permit the licensing of such person.

A STUDY OF PAINT VEHICLES.

AN INVESTIGATION OF THE VALUE OF CERTAIN PAINT OILS, AND OF THE EFFICIENCY OF DRYING MATERIALS.

Henry A. Gardner—Journal of the Franklin Institute.

FOR certain technical paints, linseed oil is not an entirely satisfactory vehicle, and the search for a substitute has received a good deal of attention from paint chemists. Just at present interest in the problem is unusually keen, on account of the comparative scarcity of linseed oil, and for the same reason the market is flooded with so-called substitutes. None of these, according to Henry A. Gardner, has yet demonstrated that it possesses a practical efficiency greater than that of linseed oil. Mr. Gardner has been engaged for some time in an investigation of the various oils offered as paint vehicles. His results, which are published in the *Journal of the Franklin Institute* for January, indicate that many oils other than linseed may possibly be of use as paint vehicles, but he is careful to point out the danger of using them until their composition is understood or their value determined in a practical way.

"It is well known that a most desirable feature of paint oils is their ability to set up in a short period to a hard surface that will not take dust, that will stand abrasion and offer resistance to moisture and gases. This drying property is dependent upon the chemical nature of the oil. If it is an unsaturated compound, like linseed oil, rapid absorption of oxygen will cause the film to dry rapidly and become hard. If the oil be of a fully satisfied nature, like mineral oil, for example, oxygen cannot be taken up to any great extent and drying will not take place. The various animal and vegetable oils differ in their power of oxygen absorption to a lesser or greater extent. This difference is referred to by the chemist in terms of the iodine value. The iodine value of linseed oil is approximately 190, meaning that one gram of the oil will take up 190 centigrams of iodine."

Soya-bean oil, obtained from the seeds of the *Soya Hispida,* a plant indigenous in Manchuria but raised extensively in the Southern States for cattle food, is being imported into the United States in large quantities and is being exploited as an efficient paint vehicle. Its iodine value is around 130, and its iodine value is the only chemical characteristic that markedly differentiates it from linseed oil. As to the most efficient drier for use with soya-bean oil, Mr. Gardner has found that the percentage of lead or of manganese, or of lead and manganese, giving maximum efficiency in the drying of linseed oil gives also the best results with soya-bean oil. Soya-bean oil paints without drier, however, take about twice as long to dry as similar linseed-oil paints, although laboratory tests with mixtures of the two oils indicate that a moderate percentage of soya-bean oil is not detrimental with linseed oil.

Tung oil, or Chinese wood oil, used extensively in the manufacture of varnishes, has been seldom, if ever, used as a paint oil. Yet for certain technical paints for the protection of concrete and steel, for the waterproofing of structures, and for other purposes, manufacturers may find this oil, or its products, most useful. Metallic tungates have been shown to be most excellent driers, and the high iodine value of tung oil, around 170, makes it a very rapid drier, even faster than linseed oil. The soft and opaque film it leaves upon oxidation, however, makes necessary treatment by special processes when it is used for either varnishes or paints, except in special cases. Mr. Gardner has prepared the tungate of lead by precipitating saponified tung oil with lead acetate. This tungate, after it has been freed from water, may be fused with a small percentage of colophony and borate to produce a rapid drier which gives a perfectly clear film.

Menhaden oil, derived from marine animals, has an iodine value around 160. It dries fairly rapidly and its composition would indicate that it might possess considerable merit. Toch claims that it is of great value for smoke-stack paints, and for zinc paints exposed at the sea shore. Its content of stearine may account for certain waterproofing properties claimed by producers, and would suggest its use in paints for the protection of iron and steel.

Of the other oils investigated by Mr. Gardner, rosin oil, the product of the dry distillation of rosin, has a low iodine value and a high acid value which unfit it for use as a paint vehicle. Cottonseed oil and corn oil are both light in color, and although greatly inferior to even soya-bean oil in drying action, merit further investigation. Sunflower oil is high in iodine value and light in color; it is, however, very scarce, although there is no reason why it should not be produced in larger quantities for use as a paint oil. On Perilla oil, obtained from Perilla nuts, indigenous in Manchuria and the East Indies, no tests have been made, on account of its scarcity, though it has an iodine value of 206. Waste oil, obtained from city garbage, seems to have little value as a paint oil, but its use in combination with linseed oil to produce a soft, elastic, water-repellant film for paints to protect iron and steel submerged in sea water should be studied. The blown and oxidized linseed oils, the debloomed mineral oils, and the so-called Japan oils on the market should not be used until practical tests of their value have been made.

DRYING TESTS OF OILS.

Sample.			Hours.
No. 1.	*Pine oil		2½
No. 2.	Tung oil		2¾
No. 3.	Linseed oil		3
No. 4.	Linseed oil Soya-bean oil Menhaden oil Tung oil Lead tungate	25 per cent 25 per cent 25 per cent 15 per cent 10 per cent	3
No. 5.	Linseed oil Chinese wood oil	75 per cent 25 per cent	3
No. 6.	Linseed oil *Pine oil	75 per cent 25 per cent	3
No. 7.	Linseed oil Menhaden oil Soya-bean oil Lead tungate	50 per cent 25 per cent 15 per cent 10 per cent	3¼
No. 8.	Menhaden oil		3½
No. 9.	Soya-bean oil		3½
No. 10.	Linseed oil Waste oil Lead tungate	80 per cent 10 per cent 10 per cent	3½
No. 11.	Linseed oil Soya-bean oil	75 per cent 25 per cent	4
No. 12.	Linseed oil Corn oil	75 per cent 25 per cent	5½
No. 13.	Linseed oil Cottonseed oil	75 per cent 25 per cent	6½
No. 14.	Linseed oil Rosin oil	75 per cent 25 per cent	10
No. 15.	Corn oil		8
No. 16.	Cottonseed oil		9
No. 17.	Rosin oil		Not dry in 2 days

* Pine oil referred to is not rosin oil but the high-boiling-point distillate of wood turpentine.

The accompanying table gives the results of drying tests made by painting thin films of oil on glass plates, which were exposed to the atmosphere, and the time of drying carefully observed. The results do not indicate the wearing values of the oils tested, but simply their relative drying values. In all cases except samples No. 4 and No. 7, 10 per cent. Drier X was added. Although sample No. 2, untreated tung oil, dried with Drier X more rapidly than untreated linseed oil with Drier X, Mr. Gardner believes that the linseed oil would be more serviceable. Drier X was a strong lead and manganese linoleate drier. The pine oil referred to is not the pine oil of commerce, but a material of high boiling point obtained as a by-product in the refining of wood turpentine manufactured from sawdust. Its boiling point is over 210 degrees C., as against 150 degrees C., the boiling point of ordinary gum spirits. It is almost water white, has the same penetrating qualities as the pure gum spirits, and is almost free from objectionable odor. When mixed with 50 per cent. linseed oil, this product forms a paint oil of extremely light color and most excellent properties, producing a semi-flat paint of great whiteness. If exposure tests substantiate the results of these preliminary investigations, it would appear of great importance to Southern manufacturers to produce this material in quantities by fractional distillation of the crude spirits. Its iodine value is high and its oxygen-carrying properties are good. Its evaporation leaves a durable film.

In another series of tests, Mr. Gardner has investigated the effect of driers on linseed oil. Varying amounts of lead oxide, of manganese dioxide, and of mixtures of the two driers were mixed with pure linseed oil, and samples of the mixtures were exposed for twenty days on tin plates to a current of washed and dried air, and also to a current of damp air. We have not space to reproduce Mr. Gardner's numerical data of the results of these tests, but confine ourselves to his summary of the conclusions drawn from them. "In the case of lead oxide," he says, "an increase in the percentage of lead oxide in the oil causes a relative increase in the oxygen absorption, but when a very large percentage of lead has been added, the film of oil dries to a leathery skin.

"In the case of manganese oxide, the increase in oxygen absorption on the first day is much more pronounced than is the case with lead oxides. Furthermore, the oxidation of manganese oils seems to be relative to the increase in manganese up to a certain period, when the reverse of this law seems to take place, and beyond a certain definite percentage of manganese, added percentages seem to be of no value. It was furthermore observed that the films dry to a more brittle and harder skin than is the case with lead oxide. The oxygen absorption with oils high in manganese has been noticed to be excessive, and the film of oil becomes surface-coated, drying beneath in a very slow manner, a condition that often leads to checking. The critical percentage where the amount of manganese appears to be most propitious and renders the greatest efficiency seems to be 0.02 per cent. This critical percentage, as it may be termed, should not be exceeded, and any added amount of manganese has the effect of making the film much more brittle and causes the so-called 'burning up' of the paint. The loading of paint with drier and the bad result therefrom, may be explained to some extent from the above.

"In the same way with lead driers, excessive amounts of lead oxide seem to have no beneficial effect on the drying of an oil, and when the percentage which seems to be the most beneficial. namely 0.5 per cent. lead oxide, is exceeded, the film is apt to become brittle. Oils containing lead oxide driers are less influenced in their drying tendencies by conditions of moisture in the atmosphere than oils containing manganese, but frequently, however, the former dry much better in a dry atmosphere. As a general rule, varnishes rich in manganese dry more quickly in a dry atmosphere, while those containing small quantities dry more quickly in a damp atmosphere. . . .

"The results of this investigation would indicate that when lead or manganese linoleates are used, the most efficient results may be obtained with 0.5 per cent. lead or with 0.05 per cent. manganese or with a combination of 0.5 per cent. lead and 0.02 per cent. manganese. Until more definite results have been obtained with the *tungates*, which will probably prove of exceptional interest as driers, the above driers will probably be used to the greatest extent."

STREAM GAUGING DURING THE FROZEN SEASON.

AN OUTLINE OF THE DIFFICULTIES, AND A DESCRIPTION OF THREE METHODS APPLICABLE TO DIFFERENT CONDITIONS.

C. Robert Adams—Engineering News.

ACCURATE records of stream flow are of the highest importance in the solution of engineering problems connected with the development of water power, water-supply projects for irrigation and domestic purposes, the prevention of floods, the navigation of rivers, and the drainage of overflowed and swamp lands. Largely through the studies of the Water Resources branch of the United States Geological Survey, methods of estimating stream flow during the open-water season have become well standardized. When we come to winter measurements, the case is different. The difficulties of making stream-flow estimates during the frozen season have prevented methods of winter measurement from reaching finality, and they are still in a more or less experimental state. C. Robert Adams shows, however, in an article contributed to *Engineering News* for February 2, that accurate winter determination of stream flow is largely a matter of judicious choice of gauging stations.

The estimation of stream flow during the open season involves the determination of the daily discharge at certain places known as river stations. These stations are ordinarily of two types, which require different methods of measurement. At regulated-flow stations, located at dams where water power is developed, the daily discharge is computed from ratings of the turbines, the flow over spillways, and the flow through waterways. Natural-flow stations are located at points where for a given elevation of water surface at a gauge a certain definite quantity of water is passing, and estimates at such stations are based upon rating diagrams determined from measurements of discharge taken at various gauge heights. Average daily gauge heights are obtained at a gauge, and from them the daily discharges are taken from the rating chart for the station.

Neither of these methods is applicable to the frozen season without some revision. Ratings of turbines are not affected, but ratings of wasteways and spillways are changed unless they are kept clear of ice obstruction. Where it is impossible to keep spillways and wasteways clear of ice, it is necessary to rerate them with all considerable changes in ice conditions. At natural-flow stations gauge heights become so affected by ice that in the majority of cases the open-water rating curve cannot be applied. It has been found also that gauge heights to water surface have in almost all instances no constant relation to the discharge.

Data obtained from 20 river stations of the U. S. Geological Survey, quoted by Mr. Adams, indicate that the coefficient for reducing open water to ice conditions with gauge heights to water surface (called C) is more uniform than the coefficient for reducing open water to ice conditions with gauge height to bottom of ice (called C^1). There is, therefore, a more constant relation between discharge and gauge height to water surface than there is between discharge and gauge height to bottom of ice.

Streams are determined in water-surface elevation by a successive number of what may be called "control points," varying more or less in number and in position as the river stage changes. These control points may be dams, natural falls, rapids, bars, or stretches of constricted cross section. They act in the general nature of weirs, in that the water-surface elevation for the stretch above a control point is determined by the height of water at the control point, and is so determined upstream to the next control point.

The most important thing about an ice cover, so far as winter estimates are concerned, is the extent to which it is in flotation. If the ice cover extends only part way across the channel it is not strong enough to support itself as a cantilever, and consequently must be in flotation. If it extends wholly across the stream, it is either in a state of flotation, or else acts as a beam supported at both ends. Mr. Adams quotes experimental data which indicate that in a large majority of cases ice upon frozen-over streams is actually in flotation. Considering this fact in connection with the fact that control points determine the water-surface elevation, it follows that the usual change produced by the appearance of an ice cover is to cause a general increase of water-surface elevation without increased flow.

The ice cover increases the friction of the wetted perimeter of the flowing stream, causing the water-surface slope between control points to be increased. The increase is greater in rapidly moving streams, and is practically zero in streams of small mean velocity and short distances between well defined control points. In the special case of a weir and pond the result is to cause no increase in water surface above and near the weir, and the open-water rating table for the weir will apply equally well where there is an ice cover. The same law will hold wherever the control point is well defined, when it is free from obstruction, and when the ice cover from the gauge to the control point is in a state of flotation. When the other conditions hold, but the control point becomes partly clogged with ice, the open-water rating table does not apply, but another table does apply wherein the gauge height to water surface is still applicable. When the control point is not well defined, when it is obstructed, and when the ice is not in a state of flotation, this principle applies less and less exactly until a point is reached where gauge heights to water surface do not have a simple relation to discharge. Hence, whenever gauge heights are used as a basis of winter estimates under ice cover, these gauge heights should be to water surface, and will apply only where stations are favorably located. It follows that the nearer *C* at any station is to unity, the better is that station for obtaining winter estimates. The nearer *C* is to unity, the more constant it is likely to be; thus *C* becomes a test to apply to present stations to determine in how far they are affected by ice, and also to determine the best method of making winter estimates.

Mr. Adams gives three methods of making winter estimates in the order of their efficiency. The first is recommended for present river stations where *C* remains at or near unity, and for similar station which may be located in the future. The most important consideration is the proper location of the gauge, which should be above and close to a well defined control point which will remain fairly clear of obstruction, and should be located so that all ice between it and the control point will be in a state of flotation. Mean daily gauge heights may then be applied to the open-water rating curve, though measurements of discharge may well be made once or twice during the winter as a check.

The second method is recommended for those streams where it is impossible to obtain satisfactory control points. It is practically a series of discharge measurements. A discharge measurement is made as soon as freezing commences, as evidenced by the rising gauge heights unattended by any reason for increased flow. A second measurement of discharge is then made as soon as the ice cover becomes permanent. Afterwards discharge measurements are made whenever the gauge height to water surface indicates a considerable change of discharge. Between discharge measurements estimates of flow are made by interpolation, and not by the use of gauge heights.

The third method is to use stations of the dam type, computing the flow as the sum of discharge through water wheels, through wasteways and over spillways. The procedure is to keep the wasteways and spillways free from ice obstruction, so that open-water ratings may be applied. If this procedure is impossible, it is necessary to rerate these wasteways and spillways as often as ice conditions change to any great extent. At best this third method is very laborious, and in the majority of cases will probably produce results of less accuracy than either of the two other methods of measurement.

AN OCEAN-GOING OIL-ENGINE SHIP.

A BRIEF DESCRIPTION OF THE MACHINERY OF THE TRAMP TANK VESSEL, "VULCANUS," THE PIONEER OF A NEW NAVIGATION.

The Engineer.

A LONG step in the direction of the general application of the internal-combustion engine to marine propulsion has been taken in the *Vulcanus,* a vessel designed and built in Amsterdam for service between Holland and Borneo, the pioneer of full-powered, ocean-going, commercial vessels equipped with oil engines. In the opinion of *The Engineer,* the *Vulcanus* marks the first clear step in a new epoch. One of the principal causes of delay in the introduction of the internal-combustion motor afloat has been a too servile adherence to pure motor practice, regardless of the conditions of marine-engine operation. In the powering of the *Vulcanus* a really serious attempt has been made to bring the internal-combustion engine into line with the teachings of experience and to profit by the lessons of marine steam practice. This is the most striking feature of the design of her propelling machinery, which is briefly described below, after a description in *The Engineer* for January 6.

"The ship has been constructed by the Nederlandsche Shipbuilding Company of Amsterdam for the Nederlandsche Indische Tankstoomboot Company for the carriage of three different grades of oil—petroleum, crude oil, and spirit—in bulk from the company's Borneo wells to its distributing centres. She is of the turret deck type, which is found to provide very convenient expansion chambers for the oil, while at the same time controlling the 'surge.' She is of 1,900 tons displacement, is 196 feet in length by 37 feet 9 inches beam, and 13 feet 2½ inches deep,, with a mean draught of 10 feet 2 inches; she has a speed of 8.4 knots. She is built of steel, under Lloyd's survey, with steel decks, and has the bridge amidships and machinery aft.

"It is, however, below that the real interest lies, and here will be found a six-cylinder, four-cycle, single-acting, reversible Diesel motor, having cylinders 400 millimetres diameter by 600 millimetres stroke, giving about 500 brake horse-power at 180 revolutions per minute. On entering the engine-room it is seen that the arrangement of valves follows ordinary Diesel practice, they being inverted in the cylinder heads. There are, of course, four valves, viz., those for the inlet, exhaust, fuel, and compressed air for starting. Each of these is operated by a very neat-looking, straight and symmetrical cast-steel rocker from the overhead cam shaft, those rockers for the fuel and compressed air being mounted eccentrically to each other on a common pivot, the position of which is controlled by a lever on the starting platform, so that when one is in gear the other is out of action, and *vice versa,* as will be mentioned later. Then comes what is probably the most interesting part of the whole engine—the valve actuating and reversing arrangement. Running along the front of the cylinders is a shaft corresponding exactly to the weigh shaft of the reversing gear of a steam engine, but instead of the arms, drag links and links, it carries rigidly attached to it Y-shaped brackets, the arms of which terminate in adjustable bearings in which run two cam shafts, one for ahead and one for astern going. At the after end of this weigh shaft, and separate from, but concentric with it, is a short length of shaft, with a two-throw crank between the two bearings, in which it is supported, and having attached to its forward end by a flanged coupling, a small toothed pinion. This pinion meshes with two spur wheels of double the diameter on the ends of the cam shafts, and thus it will be seen that the weigh shaft rotates the spur wheels round the pinion and sets either the ahead or the astern cam shaft in position to operate the rockers, and thus ahead or astern movement will be obtained, while both the spur wheels remain in gear, and both shafts are in motion when the engine is running. Rotary motion is transmitted from the engine to the little crank shaft mentioned above (and so through the pinion to the cam shafts) by means of a pair of hollow coupling rods, working at their upper ends on the two little cranks and attached at the lower ends to eccentrics on the main shaft.

"The next point to notice on the way down to the foot-plate is the arrangement of cylinders, pistons, and rods. The cylinders are cast in two blocks of three each, with open bottoms, and fitted with cast iron liners. The pistons are not of the trunk type, as usual, but are short pistons, each having no less than ten rings to make sure of retaining the high compression pressures. They have no side thrust to take up. They are hollow and are cooled by air supplied by a fan, friction-driven off the fly-wheel of the engine. This air is admitted by means of telescopic tubing into the body of the piston and exhausted into the atmosphere. The piston-rods are provided with a spigoted coupling at the top, by which they are attached by studs to the piston; the rods then pass through bushes into the crank case, and so to an ordinary marine type of guide shoe, working in a single bar guide carried in the cast frame, which forms the back of the crank case and the support for the cylinders. Narrow portable cast iron T-shaped columns are also fitted in front as additional struts to the cylinders, and to form supports for the large oil-containing wrought iron doors, which are fitted right across the front of the engine and the cast iron ends. Forked connecting-rods of ordinary marine type are fitted to the six-throw crank shaft, the three forward throws of which are arranged at 120 degrees, the three after ones dividing up these angles, so that the order of firing is 1, 4, 2, 5, 3, 6.

"Coming down to the footplate, the various control levers are arranged exactly with the appearance of a steam engine. In the middle is the reversing wheel, with its axis inclined upwards through a worm and quadrant to what we have called the weigh shaft, with to the back of the engine, and connected its pointer indicating the position of the 'links.' To the left is the throttle valve acting on the fuel. To the right are the levers which control the position of the compressed air and fuel valve rockers, and below these is the valve for shutting off the compressed air for spraying the fuel. Still confining ourselves to the description of the mechanical features to be seen, and omitting for the present all discussion as to principles and methods of operation, we find at the after end of the engine the two eccentrics for driving the 'valve gear' and the fuel pump with its gear. In this engine there are only two fuel pumps instead of one to each cylinder, as is usual. The pumps are horizontal, and are driven by a link off one of the coupling rods. One pump is used as a fuel pressure pump for injecting the oil into the cylinders; the other is a stand-by. Attached to the discharge pipe of the pump is a cleverly designed balance gear, consisting of a ram upon which the oil pressure acts, working against a ram of slightly larger diameter acted upon by the high-pressure air, and so arranged that when the oil pressure exceeds the air pressure by the predetermined amount, the rams descend and lift the suction valve of the pump until such time as the pressure has fallen again. Aft of the eccentrics come five ordinary horseshoe thrust collars and a 6-foot diameter fly-wheel.

"Coming round to the back of the engine, there are to be seen the three-stage air compressors, the first stage being a single water-jacketed cylinder driven by links and rockers off one crosshead, the second and third-stage compressors being contained in a single casting driven off a different crosshead, with coolers fitted between Nos. 1 and 2 and again between Nos. 2 and 3. Below the first-stage air compressor are the two water pumps—one for the cylinder cooling water and the other for bilge or deck purposes.

"In the wings on the port side is a two-cylinder 40-50 horse-power Diesel engine of the ordinary type, driving a special two-stage air compressor for filling the air tanks for starting and manœuvring the main engines, and having also a pulley at the forward end driving by means of a belt a specially designed centrifugal pump for discharging the cargo. In the starboard wings are four compressed air tanks of very large capacity for starting purposes, and holding air compressed to a pressure of 300 pounds per square inch. . . .

"The only other auxiliary in the engine-room is a 10 horse-power two-cylinder electric-lighting Deutz motor, and a remarkable contrast is thus afforded with the usual steam engine-room, with the feed pump, evaporators, condensers, etc., accounting in some degree for the fact that only four hands are carried on the engine-room staff. On deck there are four 4½ inches by 8 inches ordinary steam pattern cargo winches, together with a windlass worked by compressed air with a pressure of 60 pounds to 80 pounds, obtained from the tanks through a reducing valve.

"It may here be stated that no attempt at weight cutting has been made in this endeavor to produce a really satisfactory marine internal-combustion engine, the engine itself weighing 42 tons, and the whole machinery, including pipes, complete, amounting to 85 tons. The height of the engine from the centre of the crank shaft is just over 12 feet, and the length just over 25 feet. The fuel used is Tarakan crude oil, a Borneo product with a specific gravity of .950 at 15 degrees C., which costs 38s. per ton, and of this the guaranteed consumption is .42 pound per brake horse-power per hour at full speed; .44 pound at three-quarter speed; and .5 pound at half speed — a truly remarkable performance."

It will be noticed that the whole engine has been designed to follow, as far as possible, ordinary steam-engine practice—to have easily adjustable parts, to be easily accessible for examination of vital parts, to have parts which can be easily replaced in out of the way corners of the world, and to have the parts so substantially constructed that they shall not be liable to derangement. The builders have employed an ordinary short piston, with a piston rod and slipper guide, and they have used the familiar type of marine connecting rod. Furthermore, the handling of the engines bears a close resemblance to the handling of the steam engine. This close adherence to the normal design of steam marine engines is mentioned with unqualified approval both in the articles descriptive of the *Vulcanus,* and in an editorial in *The Engineer* for January 13. To quote from the latter: "In the course of time, as a new race of sea-going engineers spring up, we shall no doubt see the marine oil or gas engine developing characteristics of its own; but until then there can be no question of the wisdom of introducing the new thing with as little variation from the old and familiar as possible. Step by step desirable changes may be effected, but to throw them all at once before the engineer would be to court prejudice and trouble."

THE FIELDS FOR JET AND SURFACE CONDENSERS.

THE FIELD IN WHICH EACH TYPE MAY BE PROFITABLY EMPLOYED IN CONNECTION WITH HIGH- OR LOW-PRESSURE STEAM TURBINES.

R. M. Neilson—The Engineer.

WE have already published in these columns abstracts of two of the highly practical papers on the economic aspects of surface-condenser design contributed by R. M. Neilson to *The Engineer* at intervals during the last few months. In September last we dealt with the effect of the outlet temperature of the circulating water on the quantity of water required, and in December with the relation of the velocity of the circulating water to condenser-plant economy. In the following pages we present in abstract Mr. Neilson's latest contribution to condenser literature, which appeared in *The Engineer* for December 23, 1910. It is intended to indicate the fields in which surface condensers and barometric jet condensers may profitably be employed, in conjunction with steam turbines using either high- or low-pressure steam, in those cases in which the choice of the one or the other type is not imperatively demanded by the special conditions.

Many cases arise in which there can be little doubt as to the better system to adopt. For example, if plenty of condenser water is available, but the water is not suitable for boiler feed, it is advisable to employ surface condensers. In cases where the water is too bad, not only for use in boilers but also for use in surface condensers, though usable in jet condensers, the conditions, of course, demand the choice of condensers of the latter type. The more difficult cases may be divided into two classes: first, those in which a plentiful supply of water, usable both in boilers and in surface condensers, is available; and second, those in which water suitable for use both in surface condensers and in boilers is available only in small quantity or at a high price. In both cases either jet or surface condensers may be employed, the second class involving the use of a cooling tower or some other water-cooling arrangement.

While jet-condensing plant involving the employment of barometric water-discharge pipe costs less than surface-condensing plant to maintain the same vacuum under the same conditions, more power is required to drive the air pump in the jet-condensing system on account of the air admitted to the condenser with the condensing water. Water in motion in contact with the atmosphere often contains over 3 per cent. of air by volume, and sometimes over 4 per cent. The air admitted to a jet condenser with the condensing water is usually of more importance in turbine plants than in plants driven by piston engines. Turbine plants usually require higher condenser vacua and employ a greater ratio of condensing water to steam for the same admission temperature of the circulating water. Further, if care is taken in the operation of turbines, very little air should be admitted to the condenser with the exhaust steam. Unless there is direct leakage to the condenser, this small amount of air is all that gains access to surface condensers, while jet condensers receive in addition the air carried by the condensing water. Hence the ratio between the air-pump power required respectively in the jet system and in the surface-condensing system is usually much greater when the two systems are compared for turbine plants than when the comparison is made for piston engines.

The difference in pressure between the condenser and the exhaust end of the turbine is a most important factor in condenser-plant costs. A certain difference in pressure is necessary in order that a flow of steam may take place, but it is worth while going to some trouble and expense to prevent the difference from reaching a high value. It is usually possible to obtain a short and direct connection between a surface condenser and the turbine which exhausts into it, and thus to reduce the difference in pressure between turbine exhaust and condenser to an almost negligible value. With a barometric jet condenser, on the other hand, the necessity of drawing the wet steam through a long exhaust pipe, which usually contains two bends and in the lower part of which water is likely to collect, tends to produce a considerable drop of pressure between the turbine and the condenser. It is, therefore, necessary to design a barometric jet condenser for a higher vacuum than would be necessary with surface-condensing plant to maintain the same terminal pressure at the turbine.

The barometric jet condenser, however, requires less power for pumping the condensing water than the surface condenser. This is due to the fact that the vacuum in the jet condenser can be employed at least to assist in drawing the condensing water into the condenser, while the water is discharged by gravity. In the surface condenser a certain frictional head has to be overcome. The jet condenser loses a part of this advantage when a cooling tower is employed. It is usually expedient then to employ two condensing-water pumps, one delivering to the condenser and the other to the cooling tower. In the case of a surface condenser, one pump can perform both functions.

In order to ascertain which plant it is best to employ in any non-obvious case, it is necessary to compare the capital outlay with the running costs. The relative importance of first cost to operating cost decreases as the load factor increases. Mr. Neilson investigates the case of condensing plant for a 3,000-kilowatt turbine. The fixed annual costs, which are proportional to the capital outlay and are independent of the load factor, are taken at 15 per cent. for surface condensers and 13½ per cent. for barometric jet condensers, a cooling tower being included in each case. When a cooling tower is not employed, the corresponding figures are 13 per cent. and 11 per cent. The annual running costs, which are proportional to the load factor or to the number of working hours in the year, differ chiefly in the item of power required to run the air pump. The cost of this power, with incidental expenses, has been taken at 0.6d. per effective horse-power hour.

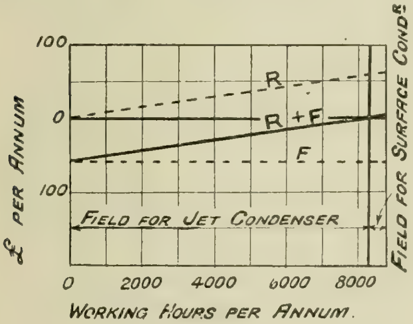


FIG. I.

Figure 1 represents a case where a cooling tower is employed and a turbine terminal pressure of 2 pounds per square inch is desired. The natural-draft cooling tower is capable of reducing the temperature of the condensing water to 82 degrees F. The cost of the surface-condensing plant, including the cooling tower, is estimated at £3,860. In estimating the cost of the jet condenser, the condenser pressure is assumed to be 0.13 pound per square inch less than that at the exhaust end of the turbine. On this assumption, the cost of the jet-condenser plant works out to £3,710. The ordinates in the figures represent annual costs, distances below the zero line being in favor of the jet condenser and distances above the line in favor of the surface condenser. The actual costs are not indicated on the diagrams, but only the differences between the costs for the rival plants. In Figure 1 the line F represents the difference between the fixed annual costs, which for the case under consideration is £79 in favor of the jet plant.

Curve R in Figure 1 represents the difference in running costs for any number of working hours per year from nothing up to 8,760, which represents continuous working. In calculating this curve, the air pump of the jet-condenser plant is estimated to require 14.13 horse power, costing 8.5d. per hour at full load. The corresponding figures for the surface-condenser plant are estimated at 7.76 horse power and 4.7d. per hour, making a difference in cost in favor of the surface-condenser plant of 3.8d. per hour at full load. The cost of driving the water pumps is assumed to be the same in both cases. The line R+F represents the algebraic sum of the ordinates of the lines R and F and shows the net difference in annual cost of the two systems for any number of working hours per year. It will be seen that the jet condenser has the advantage up to 4,989 hours per annum, after which it is superseded by the surface condenser. Hence, when the working hours are less than about 5,000 per year at full load it is advantageous to employ a jet condenser, but when the full power is carried for more than 5,000 hours per year, a surface condenser is better.

Figure 1, then, shows that with a terminal pressure at the turbine of 2 pounds per square inch and with employment of a cooling tower, fields of considerable extent are open to both the jet and the surface condenser. For terminal pressures greater than 2 pounds per square inch the field for the jet condenser is enlarged. Terminal pressures above 2 pounds, however, are seldom desirable for steam turbines. For terminal pressures much lower than 2 pounds the jet condenser has a very limited field. Figure 2 represents the case of a plant designed for a terminal pressure of 1.5 pounds per square inch, a cooling tower being employed as before. The costs of the surface-condenser and jet-condenser plants are estimated at, respectively, £4,320 and £4,150. The difference in the fixed annual costs is, therefore, £88 in favor of the jet condenser. The working costs are higher in this case than in the case of Figure 1. This is particularly true of the jet condenser, which suffers not only from the greater specific volume of the air due to the lower pressure, but also to the greater weight of air admitted to the condenser in the condensing water. The air-pump power costs of the jet-condenser and surface-condenser installations in this case are estimated at, respectively, 26.8 and 10.9 horse power, the hourly costs at full load at 16.1d. and 6.1d., and the difference in running costs per hour at full load at 10d. It is apparent from the diagram that the jet plant has the advantage only if the plant is worked per annum an amount equivalent to less than 2,112 hours at full load.

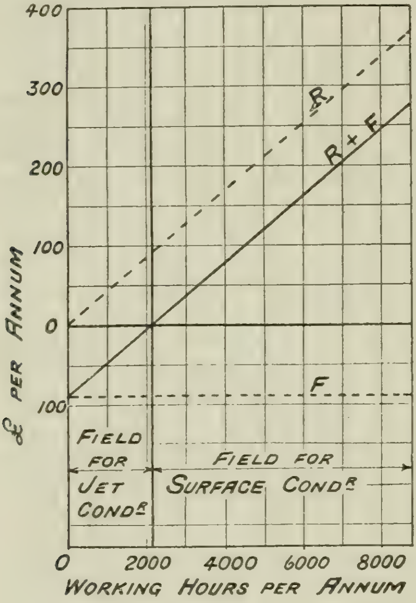


FIG. 2.

Figures 3 and 4 represent cases where no cooling tower is employed and where condensing water can be obtained at a temperature of 60 degrees F. The smaller amount of condensing water required in such cases enlarges the field for the jet condenser, so that for a terminal pressure of 1.5 pounds per square inch, as shown in Figure 3, the jet condenser has the advantage for practically any number of working hours per year. In this case the surface plant is estimated to cost £1,620, and the jet plant £1,380, the annual fixed costs in favor of the jet plant being £59. The air pump of the jet plant is estimated to require 15.7 horse power and to cost 9.4d. per hour at full load, while the corresponding figures for the surface plant are 10 horse power and 6d. In this case, however, water pumping costs 1.7d. per hour more in the surface than in the jet plant, so that the difference between the running costs is 1.7d. per hour at full load in favor of the surface plant.

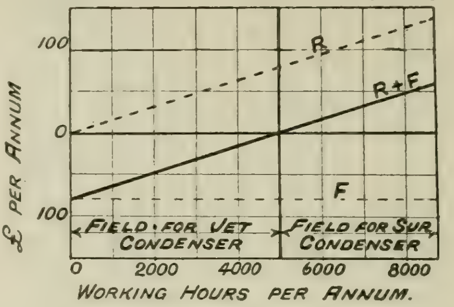


FIG. 3.

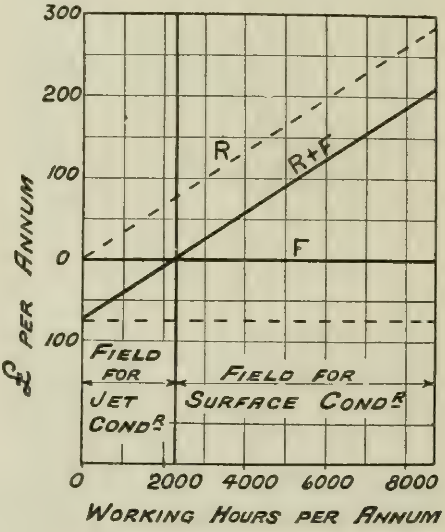


FIG. 4.

At terminal pressures greater than 1.5 pounds per square inch the jet condenser will obviously have the whole field to itself. Figure 4 represents a case in which a terminal pressure of 1 pound is required. The surface plant is estimated to cost £2,085 and the jet plant £1,800. The difference in fixed annual cost is £73 in favor of the jet plant. The air pump of the jet plant is estimated to require 28.4 horse power and to cost 17d. per hour at full load. The corresponding figures for the surface plant are 11.4 horse power and 6.8d. Allowing for a difference of 2.4d. per hour in the cost of water pumping in favor of the jet plant, the difference in running costs is 7.8d. per hour in favor of the surface plant. In comparison with the case illustrated in Figure 3, the jet plant has in this case a very limited field—only up to 2,246 hours per year—and for terminal pressures lower than 1 pound per square inch the field of the jet condenser would be still further restricted.

THE PREVENTION OF INDUSTRIAL ACCIDENTS.

A SUMMARY OF THE MOST PROLIFIC CAUSES, AND OF THE MEANS BY WHICH THE MECHANICAL ENGINEER CAN CONTRIBUTE TO THEIR PREVENTION.

John Calder—American Society of Mechanical Engineers.

INDUSTRIAL accidents in the United States take an annual toll of life and limb far exceeding the killed and wounded of several great military campaigns. The incomplete statistics published by the Bureau of Labor in the report for 1908 show that among adult wage earners alone the annual mortality from accident is between 30,000 and 35,000. In the opinion of John Calder, whose paper, "The Mechanical Engineer and the Prevention of Accidents," read at the February meeting of the American Society of Mechanical Engineers, is abstracted below, the non-fatal injuries can not be much less than 2,000,000. The remedy, says Mr. Calder, lies not in legislation, but largely in the hands of the mechanical-engineering profession, who have to deal so largely with the planning and working of industrial machinery. By no means all accidents are preventable, either by employer or employee, but if mechanical engineers will exercise proper supervision and precautions in all plants and industrial processes, and will endeavor to educate operatives in habits of care, at least one-third of the present sacrifice of life and limb can be prevented.

Mr. Calder defines an industrial accident as "any unforeseen and usually sudden occurrence which results in bodily injury to any person while present at the work place or even within the boundaries of the employer's premises." The injury, to be reportable as an accident, need not arise out of or in conjunction with the employee's assigned duties. It is the fact of injury, not the cause, which generally makes an accident reportable under the labor laws to the civil authorities. In some cases a time limit of absence from work due to accident has been fixed by statute to eliminate trivial injuries from reports, but the legislative tendency in all countries now is to call for the report of every injury without regard to its extent or the incapacity for work entailed.

From his analysis of industrial accidents, Mr. Calder has found the chief causes to be ignorance, carelessness, unsuitable clothing, insufficient lighting, dirty and obstructed work places, defects of machinery and structures, and absence of safeguards. Fire, steam generators, electricity, railroads and elevators are omitted from consideration, because to these industrial dangers, chiefly because property as well as persons is involved, engineers have already given considerable attention.

"Accidents due to the culpable as well as excusable ignorance of supervisors, engineers, millwrights, elevator men, firemen, and guardians of general facilities are frequently very serious, and nothing but administrative vigilance in selecting and instructing these employees for their own special risks will suffice to prevent such occurrences. . . . Sometimes combined with ignorance, sometimes sheer thoughtlessness, folly or horseplay, carelessness by operatives stands highest as a cause of industrial accident from the results of which nothing external can do much to shield the worker and those which he sometimes involves. . . . . The maintenance of strict discipline in the shops, the adoption of salutary punitive measures and the firm elimination of the dangerous employee is all that can be done, in addition to a campaign of education throughout the plant."

The ragged sleeve ends, loose ties and open jackets of untidy operators are responsible for many accidents at machine parts which are necessarily exposed. The large extent to which females are employed in light repetition machine work calls for special precautions regarding dress and general tidiness.

Insufficient lighting is a cause of numerous accidents, particularly serious and fatal falls. Mr. Calder has found that the number of accidents is a maximum in the months of minimum daylight. The influence of the duration and intensity of natural light in working hours on the number of accidents is particularly noticeable in the case of foundries, steel works, etc., where the operations are carried on in large spaces which are difficult to illuminate artificially. The practice of concentrating intense illumination on limited areas, leaving the other parts of the plants in semi-darkness, is to be condemned, as both dangerous and unhygienic. A more generally diffused light of less unit intensity is now easily obtained by the use of fewer but larger screened units experimentally located to suit varying shop requirements and reflecting from whitened walls and ceiling surfaces. Closely allied to defective illumination as a cause of accidents are dirty and obstructed work places. Through poor lighting, untidy habits of employees, or crowding of machines, industrial plants often retain dirty and obstructed places which cause stumbling, falls and similar accidents, and every management should see to it that the cleaning of floors and passages and the removal of wastes is systematically provided for.

Defects in machinery and structures are responsible for some accidents, but not for as many as are commonly supposed. It is, however, not unusual to find workmen, even when the best materials and apparatus are available, showing disregard for their own safety and that of others, especially in framing structures of a temporary nature. Workmen of this type should be eliminated as unfit and dangerous, and the ability of any untried operative to construct safe facilities for himself and others should never be taken on trust. Besides, overloaded machines and structures, decayed gangways, worn-out floors and stair treads, unannealed chains and hooks, frayed and stranded ropes and tackle and a host of minor items of industrial equipment should be subjected to systematic and intelligent review.

The absence of safeguards, though not the most prolific cause of accidents, closely concerns the mechanical engineer. Lack of efficient supervision often renders ineffective such safeguards as are provided. The safety engineering of no plant should be left to the haphazard initiative of a number of individuals.

The mechanical engineer may contribute to industrial safety in two ways: first, by the safeguards which he may design as an integral part of the machine tools and other apparatus supplied by him for use in the arts; and, second, by the safeguards which he may later devise and supply as the engineer or executive of plants using power apparatus and other equipment capable of inflicting injury as installed, and which cannot be intelligently protected until all related apparatus is in position and the operating conditions for employees fully apparent.

Machine-tool builders have already accomplished a great deal in the safeguarding of machinery, particularly in the protection of toothed gears in metal-working and other tools, although Mr. Calder gives an example of a so-called guard which is in reality a snare. Shafts and spindles, low pulleys, belts, intaking sides of gears, narrow clearances between fixed and moving parts, couplings, projecting screws, nuts and pins and numerous similar risks on moving parts of machines as designed are best handled for protection by the machine builder, and Mr. Calder gives a number of illustrations of what machine builders are now doing for the protection of workmen against risks of this character. He also illustrates methods of safeguarding equipment built into position, which includes power generators and a very large class of machines and industrial apparatus whose accident risks at dangerous parts depend upon the environment, the manner of installation and the precise nature of the workmen's duty around them. "Protection against accident at such apparatus is not secured, as is sometimes supposed, by guarding merely the dangerous moving parts. All stationary portions of such prime-mover structures as may cause injury to attendants and others should be equally included in the scheme of protection. In power houses the edges of all stairs, platforms, ladders and gratings should have low fenders of metal on both sides which will prevent nuts, bolts, tools, and other small parts rolling off into the machinery or striking employees in their fall. . . . Engine attendants have necessarily to operate often where the footing is slippery and insecure, and should be safeguarded when reaching out to bearings close to crank pits and other parts, or in passing around tail rods and under low fly balls and other similar parts which can and do cause many serious and not a few fatal injuries, particularly on the older prime movers still in service." To the guarding of transmission machinery also Mr. Calder devotes a good deal of attention, and illustrates guards for shafting, bearings and pulleys, desirable types of shaft couplings, collars and set screws for transmission apparatus, and safe belt replacement poles.

The most difficult safeguarding problems for the engineer are those relating to the numerous machines which are essentially dangerous at the operating point. No such machine is effectively protected by any guard which hampers a workman, reduces his speed and earnings or has not been designed for the actual working conditions. Mr. Calder illustrates the problem of the especially dangerous machine by means of four examples, probably the most prolific in accident to the operator when performing his usual duties. These are woodworking saws and cutters, punches and presses, rolling machinery of all kinds where hand feeding is necessary, and emery and other grinding wheels. Mr. Calder gives many illustrations of safeguards for machines of these classes, to show that they are all capable of efficient protection.

"The installation of machinery in relation to walls, passages, and adjacent tools and equipment deserves careful consideration. In any confined space over which any person is liable to pass and towards which the carriage of any self-acting or automatic reciprocating machine runs out, there should be left a clear 18-inch passageway between the carriage when fully out and the wall or other fixed structure not part of the machine. Danger due to position also arises in connection with limited clearance between other travelling or reciprocating machine parts and walls and fixed structures, as well as at the openings in the fixed machine framing which they pass. . . . Where the speed of the fixed reciprocating part is considerable, and a blow rather than a gentle push would be caused by accidental contract with it, the path of the piece should be screened off permanently at the extreme end of its maximum working stroke."

The most serious injuries in connection with fixed structures inside plants occur in chemical and other works where large open receptacles for stock at a high temperature or chemically dangerous are in common use, and the processes are necessarily continued day and night. Mr. Calder has found the best arrangement in such cases to be that where the top 3 feet of the vat or tank is used as a guard or fender, and the working platform is this distance below the edge or lip of the dangerous vessel. Gangways over tanks and vats should be double railed on each side and their efficient maintenance closely watched. It is also well to round off the edges of open tanks or vessels, so that they offer no foothold.

"Safeguards, where at all possible, should be constructed of metal to secure durability. Reinforced steel mesh work is to be preferred for all but the heaviest machinery. It is superior to guards of opaque material since it permits easy inspection without detaching the safeguard and interferes as little as possible with lighting conditions. In steel mills, foundries and heavy work plants of various descriptions, where the wear and tear of equipment is very great, nothing but strong castings or steel plate work should be used for the majority of the guards."

Warning and caution notices should be sparingly used and should be as brief as possible. They are practically worthless if no attempt is made to enforce them. The efforts of well instructed and sympathetic foremen receiving full credit for the safe working of their departments, and a few well considered and enforced regulations prominently displayed in print are far more effective than a long catalogue of works rules which few will read and none will remember.

Mr. Calder recommends the provision in every works of facilities for giving first-aid service within the plant to every injured person. He also suggests, in conclusion, that "every works executive and engineer will find it a valuable adjunct to the safety engineering of the plant to maintain in every department, apart from labor law and casualty insurance reports, a full and accurate record of every accident and also of every near accident. Periodical examination of these and the determination of every mechanical engineer to practice safety engineering to the best of his ability, without regard to the legal minimum or compulsion, will help more than anything else to remove a great reproach from our industrial life."

CASTINGS TO WITHSTAND HIGH PRESSURES.

AN INVESTIGATION OF THE PRODUCTION OF CASTINGS OF NON-FERROUS ALLOYS TO WITHSTAND HIGH HYDRAULIC OR GASEOUS PRESSURES.

H. C. Carpenter and C. A. Edwards—Institution of Mechanical Engineers.

FOR over three years Prof. H. C. H. Carpenter and C. A. Edwards have been engaged in an investigation of the production of castings of non-ferrous alloys capable of withstanding high hydraulic or gaseous pressures, such as are used for high-pressure pumps, steam valves, gun mountings, and many other purposes. Hitherto it has been possible to obtain sound castings for pressures up to 20 tons per square inch without resort to some type of steel, which is unsuitable for the purposes mentioned on account of its corrodibility, but without any degree of regularity. The results of this investigation, briefly summarized below after a long report presented to the Institution of Mechanical Engineers on December 16 last, establishes a sound scientific basis for the production of high-pressure castings of non-ferrous materials.

The authors introduce their report of the investigation with a short *résumé* of the principal materials used in present practice, and of the practical difficulties which have to be overcome in the production of sound castings. The alloys in current use fall into two main classes. Either they are gun metals with copper and tin as their principal constituents, or they are complex brasses with copper and zinc as their principal constituents. The former usually contain zinc, and may also contain lead and manganese; the latter ("manganese bronzes") contain iron, manganese, tin, and in some cases aluminium among their minor constituents. The difficulties in casting may be summarized under three main heads: first, those liable to be caused by the metal or alloy, which include (1) dross or scum, due to oxidation; (2) piping, due to shrinkage of the fluid metal; (3) sponginess, due to the trapping of gas; (4) heterogeneity, due to segregation; (5) stresses, set up in the solid alloy by unequal contraction; (6) deterioration, due to structural or molecular changes in the alloy with lapse of time; second, those liable to be caused by the pattern, which include (1) stresses, set up during cooling by abrupt changes in thickness of section; and (2) planes of weakness, caused by crystals growing in a particular direction; and third, those liable to be caused by the mould, limited to blow holes caused by the mould being too hard or too damp, or to the sand containing rust or scale.

The properties desired in the castings were: mechanical strength, including rigidity and ductility; homogeneity; soundness; freedom from liability to deterioration; and minimum corrodibility in fresh and sea water. The method adopted by the authors was to start with the simplest case possible and to work out the conditions for success, bearing in mind the limitations imposed by practice; having achieved this, to introduce one variable or complication at a time, and to work out the conditions for its success, before proceeding to the next. In the tests, the castings were machined, and if they appeared clean and sound, a valve was fitted into them. The pressure was first taken up to 4 tons; castings which held this without the least sign of leakage for twenty-four hours were then tested on a high-pressure hydraulic pump, capable of raising the pressure to 20 tons. All the castings which passed the preliminary tests were tested at pressures varying from 14 to 20 tons.

The authors first attacked the problem of selecting a suitable material for high-pressure castings, and experimented with cylinders of pure gun metal, cast in chill moulds and machined to 5¾ by 2¼ inches, the bore and thickness of wall being each ¾ inch. The material contained only copper and tin, in the proportion of 85 to 15, with a little phosphorus, not over 0.1 per cent. in the cast alloy, added to remove oxygen. Castings were repeatedly produced which were perfectly sound, and after machining withstood pressures averaging 18 tons before they burst. So far as chill casts were concerned, this pure gun metal, *when freshly cast,* gave quite satisfactory results. Castings made in sand moulds were less satisfactory; in no case could the pressure be taken above 7 tons. Finally the authors abandoned their experiments with gun metal when they learned that alloys of this composition deteriorate with lapse of time.

They next turned their attention to the aluminium bronzes, which they had already investigated for the Alloys Research Committee. These alloys offered the advantages of homogeneity; considerable tenacity and ductility, the former rising and the latter falling as the aluminium is increased; ease of preparation; and very slight corrodibility. Tests on 9 per cent. aluminium bronze showed that it is possible to cast cylinders of this material both in chill and in sand moulds, which are not burst by water pressures of 18 tons per square inch. Their only drawback was that they began stretching at pressures of 10 to 12 tons, the sand castings giving the lower figure. Accordingly the authors experimented with stiffer materials produced by increasing the percentage of aluminium in the bronze. Alloys containing up to 11 per cent. of aluminium were tested. Up to 10 per cent. it is practically impossible to break a sound casting by hydraulic pressure, owing to the gradual stretch of the material. The most serviceable bronzes under this test are those containing from 10.5 to 11 per cent. of aluminium. They are stiff and tough alloys and break with considerable extension.

Alloys of suitable composition having been found, the authors turned their attention to the casting of the aluminium bronzes in more complicated forms. The type chosen was a hydraulic valve block. The first castings were rendered useless by the formation of dross, and efforts were made to clean the metal by the use of deoxidizing agents. Still, the formation of dross persisted, and the authors were led to the conclusion that the dross was in some way formed inside the mould. It was finally discovered that the dross was caused by the formation of large amounts of alumina when the metal was poured so as to cause agitation sufficient to break the skin of alumina formed as soon as the metal reached the mould. A complete remedy was found in pouring the aluminium bronzes as quietly as possible and in preventing any agitation in the metal after it had reached the mould.

Summing up the results of this investigation, "the conditions have been worked out under which non-ferrous hydraulic castings, capable of withstanding pressures varying from 14 to 20 tons, can be produced. Castings of the same composition will be capable of holding gas pressures of 2,000 to 3,000 atmospheres at the ordinary temperature. These results have been obtained by the use of pure copper-aluminium bronzes containing from 9 to 11 per cent. of aluminium, according to the size and shape of the casting, and permitting considerable latitude as regards the degree of 'stiffness' required. The largest casting experimented with weighed 36 pounds, including the gate and riser. The most suitable compositions for these are the bronzes containing from 9 to 10 per cent. of aluminium. Higher percentages can be employed only with small castings.

"The following precautions have been found essential:—

(1) The alloy must be poured very slowly.

(2) It should be cast at a temperature of not more than 50 to 80 degrees C. above that at which freezing begins.

(3) The gate should be so arranged that the metal enters the mould at the lowest possible point. Broadly speaking, almost any form of gate will do, but it has been found advantageous to provide a sort of well at the bottom of the mould and to use a rather narrow opening for the entrance of the metal.

(4) In the case of green-sand moulds, care must be taken that the sand is not too damp, particularly in the lower parts where the metal rests on it. If a rather close sand is used it is far safer to dry the surface of the lower part of the mould.

(5) In large castings the use of risers is essential to overcome the shrinkage of the alloy.

"If these conditions are observed, after sufficient practice, castings can be regularly made that are absolutely free from dross and nearly always sound. The average is not less than four clean, sound castings out of six."

RAILWAY COLLISIONS IN THE UNITED STATES.

LACK OF DISCIPLINE AS AN IMPORTANT CAUSE, AND THE POSSIBILITY OF REDUCING THE NUMBER OF ACCIDENTS BY THE INTRODUCTION OF AUTOMATIC TRAIN-STOP DEVICES.

Report of the Block-Signal and Train-Control Board.

SINCE the preparation of our review in the last issue of THE ENGINEERING MAGAZINE of M. Hoogen's summary of the results of the trials on German railways of devices for the prevention of overrunning of signals set at "danger," the third annual report of the United States Block-Signal and Train-Control Board to the Interstate Commerce Commission has been made public. A large part of the report deals with the automatic-stop devices submitted to the Board for investigation. These devices are based, in the main, on the same principles as the devices investigated in Germany, and the experience of the Board has been similar to that of the German railways. Of the 149 signal and automatic train-stop devices submitted to the Board, only 16 have been considered of sufficient merit to warrant extended tests. Two mechanical trip devices have given results which indicate that their use would materially promote safety in railway operation, but the Board consider it improper to make any recommendations concerning the compulsory adoption of automatic train stops based on them alone.

We are not concerned, however, with that part of the report which deals with the various devices investigated by the Board and with their estimate of the practical utility of individual apparatus. The most striking feature of the report is a discussion of the larger aspects of train control by means of automatic-stop devices, and of the superior importance of *personnel* to mechanical devices as factors in the problem of reducing railway collisions. From this part of the report we quote at length:

"Collisions resulting from the weaknesses in the time-interval or train-dispatching system, and the deficiencies in the block system due to untrained or undisciplined signalmen, as well as errors on the part of enginemen and trainmen, have led to public demand for automatic devices. Many seem to believe that the introduction of the automatic train stop would greatly diminish railroad collisions of all classes.

"While it is true that the use of automatic features in the block system itself, as a result of which block signals are actuated directly by the movements of the train, would greatly diminish the number of collisions due to errors in manual block working, the fact should be clearly borne in mind that the automatic stop corrects but one defect, namely, the failure of the engineman to observe, understand, and obey signal indications. It does not in any way insure that the indications displayed will be correct, nor in any way prevent collisions due to the inherent defects of the dispatching system nor to improper working of the block system.

"This, however, should not be construed as in any way minimizing the importance of the automatic stop, for it is a well-known fact that many accidents have been caused by the failure of enginemen to observe, understand, and obey signal indications. Failures to observe signals may be due to fog, snow, signal light not burning, or smoke from other trains; failure to understand or comprehend the signals may be due to complexity in the system of indications or to diversion of the engineman's attention or to his physical incapacity; failure to obey indications that are seen and comprehended are rare, and comprise only those cases where enginemen desiring to make time are tempted to take chances, or to a too liberal interpretation of rules which allow the enginemen some discretion.

"Experience with automatic stops shows that under proper discipline they perform a moral function in that runners are more careful to heed stop signals when it is certain that disobedience of such signals will be detected. . . . While the Board confidently expects the automatic stop to be developed to a point where, like the block signal, the car coupler, and the train brake, it will be available to railroads generally, and in many situations will constitute one of the factors promoting safety in train operation, the Board is led to believe from its study of existing conditions, particularly as found in connection with the means now employed for the safe movement of trains, that the primary cause of the lamentable record of collisions in this country is of so serious a nature as not to be susceptible to complete cure by any mechanical means. It is not to be considered that the automatic stop, or that any automatic device, will be a panacea for all the faults at present existing in train operation. The question really is whether by the introduction of automatic devices the percentage of accidents due to those faults can be reduced.

"It is an unwelcome thought that the fundamental responsibility for the relatively large number of collisions in this country is chargeable to railroad officers and employees; not to them because they are more careless or less sensible of their responsibilities than men in other vocations, for that cannot be truthfully said, but simply because they possess the qualities, mental or temperamental, which are the cause of these deplorable results, and which are symptomatic of characteristics common to all who have been reared in a new and rapidly developing country. But sober reflection leads inevitably to the conclusion that, outside of the army and navy, the American is not reared with that discipline which becomes a part of the man and governs his actions mechanically, as it were, rather than as the result of reasoning.

"Such discipline leads to action as one's first duty without question or reason, and the sense of duty is the one predominating quality which influences the man's every action unconsciously and unfailingly. This conclusion is brought home all the more convincingly when one reflects that nowhere in the world have appliances for safeguarding railroad transportation been so highly developed as in this country, notwithstanding which nowhere in the world is there a greater proportionate number of accidents of the kind which such advance in the art should prevent. The automatic stop, therefore, while it might be unnecessary under different social conditions, may be expected to add to safety in train operation under the conditions which do exist and must continue to exist in this country until we shall come to appreciate and realize all that may be accomplished by discipline of the right sort. But mere discipline will not suffice alone. There must go with it the spirit which prompts obedience for the pleasure of being approved by one's own conscience.

"It being admitted that what is most needed is automatic performance of one's duties rather than automatic mechanical devices, how may it soonest be brought about The causes that militate against the development of the human machine to perfection of disciplined action are so complex and so interwoven with our social being that many of them can be eradicated only by that slow evolution or growth which results from the operation of natural laws and which can hardly be forced or even guided by the enactment of man-made statutes.

"Nevertheless a number of these causes appear susceptible of marked and present improvement. Appeals to conscience may develop a high sense of duty in many men, but the ever-present problem of earning a living, by its very insistence, makes the appeal to self-interest powerful and practical. The pension system as in force on a number of prominent roads and as advocated by the board in its report last year is believed to offer a strong inducement to careful conduct and should be encouraged.

"The existence in the regulations of some railroad companies of rules that are unfair or non-enforceable, and intended only as an extreme legal precaution to protect the companies, is nearly as bad in its effect upon discipline as the failure of railroad officers to rigidly enforce those rules which are proper and necessary to safeguard traffic.

"The American Railway Association some years ago prepared, and with painstaking effort has since amended and improved, its standard code of rules governing train operation. It is unable to compel their use or their uniform interpretation and enforcement on individual roads. The causes heretofore mentioned and others affecting discipline have the bad effect of impelling railroad employees to move about from one road to another. This tends to decrease safety in operation by frequently placing men in unfamiliar surroundings; and the condition is made still more undesirable by the lack of uniformity in rules and procedure on different roads.

"A case where, on a single-track railroad 150 miles long, used jointly by the trains of three different companies, a system of whistle signals is used on the trains of one company which is entirely different from that used by the other two, is an aggravated example. Legislation in at least one state requires railroad companies to file copies of their operating rules with the State Railroad Commission, and makes any infraction of the rules by an officer, agent or employee a misdemeanor. From this to a federal requirement of the same nature, and, what is more important, enforcing uniformity, is but a short step and one likely to be advocated in the absence of an improvement in railroad procedure in this respect.

"The law passed by Congress at its last session authorizing the Commission to investigate train accidents, should tend to make for better methods and improvement in *personnel* by directing public attention to those defects and deficiencies which have resulted in train accidents, and thus lead to their correction. But on the theory that prevention is better than cure, it is obviously the part of wisdom to take all practicable measures beforehand to prevent those evils that have heretofore resulted in collisions rather than to wait for the occurrence of accidents to disclose the existence of the evils. Investigations such as the board has been conducting into block-signal and other operating methods, therefore, should be continued and conducted on a larger and more comprehensive scale than has been done in the past. This is necessary, with or without a law requiring the use of the block system."

THE ENGINEERING INDEX

"THE KEYSTONE IN THE ARCH OF APPLIED SCIENCE"

The following pages form a *descriptive* index to the leading and special articles of permanent value published currently in the Transactions of all the important engineering societies of both Europe and America, and in all the leading engineering journals of the world—in the English, French, German, Dutch, Italian, and Spanish languages.

The term *descriptive* is used because the definite purpose of each index note is to indicate clearly the character and purpose of the article or paper described; and with that in view we give the following essential information about every publication:

(1) The title of the article,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published,
(7) *We supply the article itself, if desired.*

☞ The full text of every article described in the Index, together with all its illustrations, can usually be supplied by us.—See the "Explanatory Note" at the end of the Index, where also the full titles of the principal journals indexed are given.

NOTE—The busy engineer will also observe that the Index is conveniently classified into the larger divisions of engineering science, to the end that the reader may quickly turn to what concerns himself and his special branches of work. By this means it is possible, within a few minutes' time each month, to learn promptly of every important article published anywhere in the world, in any language, upon the subjects claiming one's special interest.

DIVISIONS OF THE ENGINEERING INDEX.

CIVIL ENGINEERING..............Page 977
ELECTRICAL ENGINEERING........ " 987
INDUSTRIAL ECONOMY........... " 992
MARINE AND NAVAL ENGINEERING " 993
MECHANICAL ENGINEERING......Page 995
MINING AND METALLURGY...... " 1008
RAILWAY ENGINEERING......... " 1017
STREET AND ELECTRIC RAILWAYS. " 1020

CIVIL ENGINEERING

BRIDGES.

Arches.

Work on St. Martin Canal, Paris. Illustrates and describes the method of constructing reinforced concrete vaulting over a distance of 802 ft. 900 w. Sci Am—Dec. 31, 1910. No. 19786.

The Design of Two Arches Supported by One Pier (Beitrag zur Berechnung von Gewölben mit Zwischenpfeilern). Robert Otzen. Mathematical. Ills. 2400 w. Deutsche Bau—Dec. 21, 1910. No. 20461 B.

Cantilever.

The Pittsburgh & Lake Erie Cantilever Bridge Over the Ohio River at Beaver. Illustrated detailed description of the bridge and its construction. 10800 w. Eng Rec—Jan. 28, 1911. No. 20646.

The Pittsburgh & Lake Erie Cantilever Bridge Over the Ohio River at Beaver, Pa. Illustrated detailed description of this new double-track through-truss bridge of the three-span cantilever type. Plate. 6000 w. Eng News—Jan. 26, 1911. No. 20615.

Concrete.

A Heavy Concrete Bridge Built to Resist Ice Pressure. Mason D. Pratt. Illustrated description of a concrete arch bridge with concrete filling and spandrel walls, crossing Swatara Creek at Hummelstown, Pa. 500 w. Eng News—Jan. 26, 1911. No. 20620.

Design.

Deduction of a New Rational Formula for the Most Economic Length of Each of a Series of Bridge Spans. Considers not only first cost, but maintenance and depreciation. 2500 w. Engng-Con—Jan. 4, 1911. No. 20059.

Equivalent Loading in the Design of Highway Bridges (Ersatzlasten zur Berechnung der Haupttrӓger von Strassenbrücken). Johann Lipold. Mathematical, with tabular numerical data. Ills. 4200 w. Oest Zeitschr f d Oeffent Baudienst—Dec. 17, 1910. No. 20484 D.

Erection.

Incidents in the Construction of the Miles Glacier Bridge. Illustrated article describing some of the difficulties encountered on this unusual work. 2500 w. Eng Rec—Dec. 31, 1910. No. 19868.

Highway Bridges.

Relation of Bridge Specifications to Highway Improvement. Albert Smith. Read before the Indiana Engng Soc. A criticism of the practice of building new bridges which are unsafe for roadmaking machinery. 1500 w. Eng Rec—Jan. 21, 1911. No. 20345

Indianapolis.

The White River Bridges in Indianapolis, Ind. Illustrates and describes recent bridges built to carry the highways over this river which intersects the city, showing the tendency toward beauty of design. 1600 w. Munic Engng—Jan., 1911. No. 20332 C.

Piers.

Enlarging the Lachine Bridge Piers. Illustrated description of methods of reconstruction used for a bridge across the St. Lawrence River, near Montreal. 1800 w. Eng Rec—Jan. 21, 1911. No. 20346.

Reinforced Concrete.

The French Broad River Bridge, Southern Railway. Illustrates and describes a reinforced concrete girder bridge 733 ft. 10 ins. long, the approximate cost is given as $125,000. 1000 w. Eng Rec—Jan. 7, 1911. No. 20004.

Canal Bridges (Kanalbrücken). F. Steinleitner. Describes three short reinforced-concrete girder spans. Ills. Serial. 1st part. 2800 w. Beton u Eisen—Dec. 14, 1910. No. 20486 F.

Design of an Arch Bridge in Hollow Reinforced Concrete Blocks (Entwurf einer gewölbten Brücke aus bewehrten Betonhohlblöcken über die "Gula" km 431.9 der Linie Christiania-Drontheim). Jens G. F. Lund. Brief description of the materials and erection. Ills. 4000 w. Beton u Eisen—Dec. 14, 1910. No. 20489 F.

Steel.

The New Kentucky River High Bridge. Illustrated description of the new double-track structure now being erected to replace single track long span cantilever bridge. 1800 w. Eng Rec—Dec. 31, 1910. No. 19872.

Suspension.

The Stiffened Suspension Bridge Applied to a Short Span. Frank Barber. Illustrated description of a bridge over the River Don, Oriole, Ont., having a span of 90 ft., a roadway of 14 ft., and the floor 15 ft. from low water. 1500 w. Can Engr—Jan. 12, 1911. No. 20207.

Viaducts.

The Middlesex Falls Concrete Viaduct. Illustrated description of a reinforced-concrete viaduct near Boston. 1000 w. Eng Rec—Jan. 21, 1911. No. 20343.

The Erection of the Shepherdstown Viaduct. Illustrated description of methods of erection of this viaduct in W. Va. A steel cantilever traveler was used. 1500 w. Eng Rec—Dec. 31, 1910. No. 19875.

The Reconstruction of the Radcliffe Viaduct. Illustrates and describes details of the old and new Radcliffe viaducts on the Nottingham and Grantham branch of the Great Northern Railway. The old viaduct was timber; the new is constructed in brick work. 900 w. Engr, Lond—Dec. 30, 1910. No. 20098 A.

New Street Viaducts at Denver, Colo. Gives drawings and descriptions of viaducts built to carry the streets over the valley of the South Platte River, which passes through the city. 4500 w. Eng News—Jan. 5, 1911. No. 19935.

Winnipeg.

Winnipeg's Bridges. Paul Schioler. Illustrated description of bridges and viaducts across the Red River, Assiniboine River and the railways. 4500 w. Can Engr—Jan. 19, 1911. No. 20379.

CONSTRUCTION.

Columns.

Hooped Columns and the Austrian Regulations (Umschnürte Säulen und die ministeriellen Vorschriften für Oesterreich). Max Gatterer. A mathematical discussion, dealing principally with the Abramoff-Magid system. Ills. 4700 w. Beton u Eisen—Dec. 14. 1910. No. 20487 F.

Concrete.

General Concrete Practice. Thomas Potter. Abstract of a paper read before the Concrete Inst. Deals with the use of concrete in connection with buildings, apart from any association with reinforcement or steel work. 2500 w. Surveyor—Dec. 23, 1910. No. 19967 A.

Method of Designing Concrete for the Sea View Hospital. Brief description of the method of design followed in structures on Staten Island, N. Y. 1200 w. Eng Rec—Jan. 7, 1911. No. 20006.

Method of Finishing Concrete by Rubbing, Floating and Brushing, with Some Costs. S. M. Klein. Describes a method that gave very satisfactory results. 2000 w. Engng-Con—Jan. 11, 1911. No. 20118.

Mixing Concrete on the Farm. Describes how to select the materials and mix the concrete. Ills. 1000 w. Sci Am Sup—Jan. 7, 1911. No. 19945.

Depositing Concrete Under Water in France. Illustrated description of methods employed in repairing the movable dam across the River Saône at Gigny, France, as given by Henri Tavernier, in *Ann. des Ponts et Chaus.* 800 w. Eng Rec—Jan. 7, 1911. No. 20010.

The Exploitation of Concrete (Ausbeute des Betons). M. Marcichowski. A discussion of the principles of concrete mixing. 4900 w. Beton u Eisen—Dec. 14, 1910. No. 20488 F.

Contractors' Plants.

Construction Plant-Layout for a Concrete Building. Illustrates and describes a plant at Chicopee, Mass., used for the building of a 4-story reinforced concrete factory. 1200 w. Eng Rec—Jan. 14, 1911. No. 20184.

Earth Pressures.

Earth Pressures. Charles K. Mohler. A study of theories, showing lack of agreement, and breakdown in the theories when worked out for results; also formulæ and results from a new method. Ills. Discussion. 17000 w. Jour W Soc of Engrs—Dec., 1910. No. 20555 D.

Excavation.

Excavating the Pit for a Third Lock at Sault Ste. Marie. Illustrated description of methods of excavation. 1500 w. Eng Rec—Jan. 7, 1911. No. 20009.

Improvements in Spoil-Handling Plant at Panama. Describes improvements in equipment for the heavy work of handling earth and rock on a very large scale. 1500 w. Eng Rec—Jan. 14, 1911. No. 20177.

Classification of Material in the Transcontinental Railway. Gives the Classification made by the Chief Engineer in preparing the specifications, and opinions in regard to the interpretations. Ills. 3000 w. Can Engr—Jan. 5, 1911. No. 20063.

See also Submarine Excavation under WATERWAYS AND HARBORS.

Failures.

Report of the Commission Appointed to Investigate the Collapse of the Henke Reinforced Concrete Building, Cleveland, O. Also a letter from Edward Godfrey, and editorial note. 4500 w. Eng News —Jan. 26, 1911. No. 20625.

Failure of a Very Large Concrete Oil Reservoir. Illustrations of the two large reservoirs, with a capacity of 1,000,000 bbls. each, built at San Luis, Obispo, Cal., with an account of the failure of one. 600 w. Eng Rec—Jan. 14, 1911. No. 20178.

Fireproofs.

Heavy Truss Work in the Electric Building, Portland, Ore. Cross-section of a nine-story building with description. 1000 w. Eng Rec—Jan. 28, 1911. No. 20649.

Floors.

Warehouse with a New Type of Girderless Floors. Describes a new type of girderless reinforced concrete floors built in a large wool storage warehouse in Boston. 1800 w. Eng Rec—Jan. 14, 1911. No. 20183.

Foundations.

Replacing Foundations of a Steel Bridge Over a Railroad. Illustrates and describes work at Fifty-fourth St. in connection with terminal improvements of the N. Y. C. & H. R. R. R. 1000 w. Eng. Rec—Dec. 31, 1910. No. 19874.

Notable Improvements in Caisson Practice (Bemerkenswerte Neuerungen bei Druckluftgründungen). G. Lüscher. Brief description of new methods of handling materials. Ills. 1800 w. Schweiz Bau—Dec. 3, 1910. No. 20462 B.

Piling.

A Comparison of the Initial Cost of Concrete and Wood Piling. Philip J. Kealy. Analysis showing a saving in cost in favor of concrete. 1800 w. Engng Con—Jan. 25, 1911. No. 20607.

A Discussion of the Carrying Capacity of Bulb-Pointed Concrete Piles. Hunley Abbott. A study of the factors which determine the load which can be transmitted by pile foundations to the subsoil, and the most economical method of increasing this carrying capacity. Ills. 2500 w. Engng-Con—Jan. 11, 1911. No. 20119.

Larssen Sheet Steel Piling (Die eiserne Spundwand von Larssen). J. Wilhelmi. Describes the piling, the method of locking, and some works in which it has been used. Ills. 2800 w. Zeitschr d Ver Deutscher Ing—Dec 10, 1910. No. 20706 D.

Reclamation.

Draining the Everglades. Day Allen Willey. An account of this work in Florida, and the results. Ills. 1600 w. Sci Am—Jan. 21, 1911. No. 20388.

Report on the St. Francis Valley Drainage Project in Northeastern Arkansas. Arthur E. Morgan. Assisted by O. G. Baxter. General report with maps and illustrations. 40500 w. U S Dept of Agri, Bul 230. Serial. Part I—Jan. 20, 1911. No. 20671 N.

A Land Drainage Project Near Louisville, Kentucky. Map and outline of a proposed drainage system to reclaim marshes. 1800 w. Eng News—Jan. 12, 1911. No. 20140.

A Preliminary Report on the Drainage of the Fifth Louisiana Levee District, Comprising the Parishes of East Carroll, Madison, Tensas, and Concordia. A. E. Morgan, S. H. McCrory, and L. L. Hidinger. 10500 w. U S Dept of Agri, Circ. 104—Jan. 21, 1911. No. 20674 N.

The Drainage Situation in the Lower Rio Grande Valley, Texas. L. L. Hidinger. Information concerning the drainage, soils, rainfall, alkali, methods of reclamation, etc. Maps. 12600 w. U S Dept of Agri, Circ. 103—Jan. 12, 1911. No. 20673 N.

A Report Upon the Reclamation of the Overflowed Lands in the Marais des Cygnes Valley, Kansas. S. H. McCrory. Assisted by D. L. Yarnell and W. G. McEathron. General description of the watershed, river, floods, etc., with report of investigation made, and plans recommended, the probable cost, etc. Maps. 13000 w. U S Dept of Agri Bul 234—Jan. 14, 1911. No. 20670 N.

Reinforced Concrete.

Possible Defects in Reinforced Concrete and Their Causes (Importanza del Cemento armato nella Esecuzione. Difetti possibili di Questa e Cause relative). Luigi Novelli. Discusses the remarkable extension of the use of this material and the errors to guard against. Serial. 1st part. 3600 w. Il Cemento—Dec. 15, 1910. No. 20442 D.

See also Contractors' Plants, Failures, and Floors, under CONSTRUCTION; and Snow Sheds, under RAILWAY ENGINEERING, PERMANENT WAY AND BUILDINGS.

Roofs.

The Norumbega Park Theater Roof. Plans and description of the roof for an open air theater in Auburndale, Mass. 600 w. Eng Rec—Jan. 14, 1911. No. 20182.

Stacks.

The Monoshaft System of Chimney Construction. J. S. E. De Vesian. From a paper read before the Engng. Soc. of Gloucester. Illustrated description of a durable, cheap and quickly erected factory chimney. 1500 w. Col Guard—Jan. 6, 1911. No. 20259 A.

Steel.

The Curtis Power Building. Describes the power building and equipment which will serve the 12-story Curtis Building now under construction in Philadelphia, Pa. Ills. 2500 w. Eng Rec—Jan. 7, 1911. No. 20007.

The Construction and Mechanical Equipment of the Buildings of the Hamburg Warehousing Company (Die Entwicklung der bau- und maschinentechnischen Anlagen der Hamburger Freihafen-Lagerhaus-Gesellschaft). P. Eilert. The first part describes structural features of the warehouses. Ills. Serial. 1st part. 6400 w. Zeitschr d Ver Deutscher Ing—Dec. 10, 1910. No. 20705 D.

See also Fireproof, under CONSTRUCTION.

Tunnels.

Methods of Constructing the Land Sections of the La Salle Street Tunnel, Chicago. Illustrates and describes the work of construction of the approaches only. 2000 w. Engng-Con—Jan. 11, 1911. No. 20120.

Rebuilding the La Salle St. Tunnel Under the Chicago River. Illustrated description of the methods of construction of steel twin-tube concrete lined tunnels for the Chicago River crossing. 4500 w. Eng News—Jan. 12, 1911. No. 20142.

The Laramie-Poudre Tunnel. Burgis G. Coy. Describes the driving of this tunnel, which forms a part of an irrigation project in Colorado. 4000 w. Eng Rec—Jan. 14, 1911. No. 20179.

The Transandine Summit Tunnel. John Pollock. Illustrates and describes the construction of this tunnel which forms the final link in the chain connecting Chili and Argentine Republic. 4000 w. Engng—Dec. 30, 1910. No. 20091 A.

The Loetschberg Tunnel. E. L. Corthell. Map, profile, illustrations and description of this Alpine tunnel now under construction. 2500 w. Eng News—Jan. 5, 1911. No. 19933.

MATERIALS OF CONSTRUCTION.

Bituminous Materials.

See Roads, under MUNICIPAL.

Concrete.

Tufa Concrete. J. B. Lippincott. Extracts from a paper read before the Nat. Assn. of Cement Users. An account of the use of volcanic tufa in the making of concrete for the Los Angeles Aqueduct. 2500 w. Eng Rec—Dec. 31, 1910. No. 19871.

Tests to Determine the Values of Clay and Reground Cement for Securing Impermeable Concrete. O. L. Huffman and E. S. Fowler. Condensed from Bul. V., Iowa State College Engng. Ex. Station. Investigation of the value of reground cement and clay, as waterproofing materials in cement mortars and concrete. 2000 w. Engng-Con—Jan. 25. 1911. No. 20608.

Paints.

The Value of Certain Paint Oils. Henry A. Gardner. Gives a summary of results obtained from a series of experiments on paint vehicles. 4000 w. Jour Fr Inst—Jan., 1911. No. 20321 D.

Reinforced Concrete.

A Review of the Use of Reinforced Concrete in San Francisco and Vicinity. John B. Leonard. Read before the Nat. Assn. of Cement Users. 2500 w. Cement Age—Jan., 1911. No. 20630.

The Effect of Electrolysis on Metal Embedded in Concrete. Cloyd M. Chapman. Read before the Nat. Assn. of Cement Users. Gives data bearing on the destructive action. 2500 w. Engng-Con—Jan. 25, 1911. No. 20609.

Timber.

Utilization of California Eucalypts. H. S. Betts and C. Stowell Smith. Information concerning the tree and its uses, giving results of mechanical tests and information in regard to the uses of eucalyptus wood in California and Australia. Ills. 7000 w. U S Dept of Agri-Circ, 179—Dec. 29, 1910. No. 20312 N.

Timber Preservation.

Marine Wood Destroyers in the Waters of the South Atlantic Ports. W. D. Faucette. Information concerning the various species and their habitat, and methods of protection in use. 2000 w. Eng News—Jan. 5, 1911. No. 19936.

See also Poles, under ELECTRICAL ENGINEERING, TRANSMISSION.

MEASUREMENT.

Stream Gauging.

Experiments on Flow and Measurement of Water. James Barr. Abstract of paper before the Engrs' Club of Toronto. Remarks on the submerged circular orifice, the rectangular notch, and the triangular or V-notch, with report of investigations of the last. Ills. 2500 w. Can Engr—Jan. 26, 1911. No. 20668.

Gauging and Recording the Flow of Streams. Samuel C. Chapman. Read before the Assn. of Water Engrs. Notes upon the yield and gaugings of streams. Discussion. 7500 w. Surveyor—Jan. 6, 1911. No. 20249 A.

MUNICIPAL.

City Planning.

The Building of the City. Henry Leffmann. Discusses city building and what it should accomplish, outlining the building of a model city. Discussion. 3500 w. Pro Engrs' Club of Phila—Jan., 1911. No. 20576 D.

Comfort Stations.

The Most Up-to-date Public-Comfort Station in America. J. F. Brady. Illustrated description of a station of the underground type in Washington, D. C. 2000 w. Dom Engng—Dec. 31, 1910. No. 19848.

Drainage.

The Design of Storm Water Drains in a Modern Sewer System. Jean Bart Balcomb. Gives results of a study of the question at Kansas City, devoted exclusively to storm water drains. Discussion. 12500 w. Jour W Soc of Engrs—Dec., 1910. No. 20553 D.

The North Shore Drainage Channel at Chicago. Illustrates and describes this important addition to the Chicago main drainage canal, and to the sewage and water supply protection system. 1200 w. Eng News—Jan. 5, 1911. No. 19937.

See also Reclamation, under CONSTRUCTION.

Pavements.

Cement Grout Cushions in Street Railway Pavement Construction. From a report by Harry G. Davis on behalf of the Chicago Street Imp. Assn. 1500 w. Engng-Con—Jan. 25, 1911. No. 20610.

Repaving the "Loop" District in Chicago with Creosoted Wood Block. William W. Marr. Points out causes of failure in this kind of pavement, showing how better results may be obtained. Ills. 5000 w. Eng News—Dec. 29, 1910. No. 19797.

Winnipeg's Pavements. Brief description of the cedar block, macadam, and asphalt pavements, and their construction and cost. Ills. 3000 w. Can Engr—Jan. 19, 1911. No. 20378.

The Pavements of German Cities. A report on the pavements used in 80 cities having more than 5000 inhabitants. 3000 w. Eng Rec—Jan. 21, 1911. No. 20339.

Private Street Works as Administered Under the Heywood Corporation Act, 1883. Tom Fogg. Deals with the Street Works Clauses of the Borough of Heywood's Local Act. Ills. Also discussion. 4000 w. Surveyor—Dec. 23, 1910. No. 19968 A.

Refuse Disposal.

Disposition of Garbage in Various Cities. Information, from Consular Reports, concerning installations at Hamburg, London, Liverpool, Edinburgh, and Glasgow. 4000 w. Sci Am Sup—Jan. 14, 1911. No. 20174.

Plant for Handling and Storing Destructor Cinker. Illustrated description of the Westmount (Can.) clinker handling plant. 1000 w. Eng Rec—Jan. 21, 1911. No. 20340.

Roads.

The Road Problem. R. O. Wynne-Roberts. Read before the Inst. of Cleaning Supts. Discusses drainage, foundations, camber, wear, materials, and tar. 3500 w. Surveyor—Dec. 30, 1910. No. 20084 A.

The Opportunity for Technically Trained Men in Highway Work. A. N. Johnson. Read before the Am. Assn. for the Adv. of Sci. Information concerning early road building, recent improvements, and expenditures for roads, urging the training of engineers for this work. 2500 w. Eng Rec—Jan. 21, 1911. No. 20342.

The King's Highway. T. W. Wilkinson. Begins a review of the history of roads in England. The Roman roads are illustrated and described in the present number. 2200 w. Autocar—Jan. 7, 1911. Serial. 1st part. No. 20244 A.

English and American Highway Traffic Regulations. Arthur H. Blanchard and

Henry B. Drowne. Read before the Am. Assn. for the Adv. of Sci. Statements of regulations adopted in the two countries, with recommendations of regulations having a direct bearing on the design of highways. 4000 w. Eng Rec—Jan. 14, 1911. No. 20181.

Report by a Board of Engineers on the Management of the Highway Department of the State of Washington. Full report. 5500 w. Engng-Con—Jan. 25, 1911. No. 20612.

Discussion on Road Construction and Maintenance; American Society of Civil Engineers. Report of discussion on the use of oils and bitumens on macadam. 3500 w. Eng News—Jan. 26. 1911. No. 20623.

Automobile Road Building. Logan Waller Page. Brief discussion of methods, conditions, and wear. 2500 w. Automobile—Jan. 12, 1911. No. 20194 C.

Road Construction Methods in Semi-Arid Regions. Charles R. Thomas. An account of methods used to meet special conditions. 1000 w. Engng-Con—Jan. 25, 1911. No. 20611.

Notes on Roadways for Residence Streets and Thoroughfares In and About New York City. Considers the several boroughs and the suburban towns in regard to the practice of building and maintaining roads. Also editorial. 24000 w. Eng News—Jan. 19, 1911. No. 20286.

Concrete Roads in Wayne County, Michigan. Brief description of the methods of construction. 1500 w. Eng Rec—Jan. 7, 1911. No. 20002.

A New Method of Consolidating Macadam Road Surfaces (Le Problème de la Route: Essai d'un nouveau Mode de Confection des Chaussées empierrées pour Répondre aux Besoins de la Circulation automobile). C. Guillet. Describes a new machine which consolidates the road surface by a ramming action. Ills. 3200 w. Génie Civil—Dec. 31, 1910. No. 20436 D.

The Present Status of Laboratory Tests and the Use of Materials in Road Construction. Major W. W. Crosby. Read before the Am. Assn. for the Adv. of Sci. Discusses various materials, the value of available information, and the need of research work. 2000 w. Engng-Con—Jan. 18, 1911. No. 20283.

Bitumens and Their Essential Constituents for Road Construction and Maintenance. Prévost Hubbard. Describes and discusses the various bituminous materials now used in road construction. 5600 w. U S Dept of Agri, Circ. 93—Jan. 27, 1911. No. 20675 N.

Tarred Roads and Vegetation. Marcel Mirande. Read before the French Acad. of Sci. Notes on the action of tar and its constituents on vegetation. 800 w. Surveyor—Jan. 6, 1911. No. 20250 A.

Experiences of the Massachusetts Highway Commission in Road Surface Preservation Work. Harold Parker. From a paper read before the Am. Road Makers' Assn. Gives experience with Aitkin spraying machine, for spraying refined tar under pressure, and the use of asphaltic oil. 1000 w. Engng-Con—Jan. 4, 1911. No. 20058.

Dust Prevention in Berlin (Die Bekämpfung des Strassenstaubs in Berlin). Herr Szalla. Reviews the use of various methods and materials for dust prevention. 5400 w. Zeitschr d Mit Motorwagen Ver—Dec. 15, 1910. No. 20470 D.

Sanitation.

Dust, Soot and Smoke. John B. C. Kershaw. Explains scientific methods of estimating dust and soot in the atmosphere and the density of chimney smoke. 3500 w. Cassiers Mag—Jan., 1911. No. 20308 B.

Discussion of Paper "The Contamination of City Air." Brief discussion of Dr. George A. Soper's paper. 3800 w. Jour Assn of Engng Socs—Dec., 1910. No. 20549 C.

Sanitation of Villages and Premises Without Sewers. John W. Hill. From *Bul. Ohio State Board of Health.* Discusses the disposal of village wastes, including domestic sewage and garbage. 3000 w. Can Engr—Jan. 26, 1911. No. 20667.

Sewage Disposal.

Principles of Sewage Disposal. George C. Whipple. Read before the Inst. of Chem. Engrs. Discusses in detail the basic principles underlying all methods of sewage disposal. 6500 w. Eng Rec—Jan. 7, 1911. No. 20008.

Sewerage and Sewage Disposal. Considers materials used for sewers and joints, methods of purification, their possibilities and limitations, etc. Ills. 2000 w. Munic Jour & Engr—Jan. 4, 1911. No. 20013.

Sewage Sludge Disposal. W. B. Ruggles. Deals with the various methods of disposing of the solid portion of sewage. 2000 w. Eng Rec—Jan. 21, 1911. No. 20344.

Sprinkling Filter Plant for Suburban Community. Paul Hansen. Illustrated description of the College Hill plant, near Cincinnati, O. Gives details and cost of construction. 4000 w. Munic Jour & Engr—Jan. 4, 1911. No. 20012.

Sewage Disposal Plants of Atlanta, Ga. W. T. Waters. Describes the proposed system which embodies the Imhoff tank. 3300 w. Munic Engng—Jan., 1911. No. 20330 C.

The Peachtree Creek Sewage Disposal Works at Atlanta, Ga. Illustrates and describes the general arrangement of the works. Three separate purification plants were made necessary bv the topography of the country. 4500 w. Eng Rec—Dec. 31, 1910. No. 19870.

The Pennypeck Creek Sewage Disposal Works, Philadelphia, Pa. Illustrated detailed description of an experimental plant on a large scale to furnish information for the final purification of all the city sewage. It is the first Imhoff tank installation in this country. 3300 w. Eng Rec—Jan. 14, 1911. No. 20180.

See also Water Works, under WATER SUPPLY.

Sewers.

The Richmond Hill Trunk Sewer, Long Island. Illustrated detailed description of this new sewer which will collect both storm water and house sewage and discharge into Jamaica Bay. 2500 w. Eng Rec—Jan. 28, 1911. No. 20647.

Sewers and Sewer Construction in St. Louis. H. R. Fardwell. Detailed description of this combined system, its construction, and related subjects. Discussion. 5500 w. Jour Am Soc of Engng Contractors—Oct., 1910. No. 20526 N.

Sewer Construction at La Porte, Indiana. Ezra C. Shoecraft. Describes details of a combined system under construction. Ills. 1200 w. Eng Rec—Jan. 28, 1911. No. 20648.

Sidewalks.

Some Notes on Sidewalk Construction. Jerome B. Landfield. From a paper before the Nat. Assn. of Cement Users. Suggestions for concrete sidewalk work. 1500 w. Cement Age—Jan., 1911. No. 20631.

Trade Wastes.

The Disposal of Trade Wastes. George A. Johnson. Read before the N. J. San. Assn. Discusses the problems arising from their discharge into streams or sewers. 2500 w. Eng Rec—Dec. 31, 1910. No. 19869.

WATER SUPPLY.

Aqueducts.

The Disposal of Surplus Water and Electric Power from the Los Angeles Aqueduct. Burt A. Heinly. Presents suggestions for the proper distribution and sale of the surplus water and electric power. Ills. 5000 w. Eng News—Dec. 29, 1910. No. 19791.

Athens, Greece.

The Water Supply of Athens. An illustrated article describing the new works in connection with the supply from Lake Stymphalia, and the precautions necessary in a country subject to earthquakes. 3300 w. Engng—Jan. 6, 1911. No. 20261 A.

Co-operative Supplies.

The Advantages of Co-operation in Rural Water Supplies. F. Graham Fairbank. Gives the history of the rural district of Easingwold, showing that after trying to deal with the several villages in units, and failing, they had excellent results from co-operation. Map. 5000 w. Surveyor—Jan. 13, 1911. No. 20506 A.

Dams.

The Flow of Water Over Dams. Gardner S. Williams. An illustrated article giving useful data derived from model dams. 1500 w. Eng News—Jan. 12, 1911. No. 20138.

Dams, Barrages and Weirs on Porous Foundations. W. G. Bligh. Explains the principles underlying the successful design of hydraulic works founded on a loose porous foundation of sand, gravel or boulders, and deduces rules for their application. Ills. 3500 w. Eng News—Dec. 29, 1910. No. 19792.

Increasing an Ohio River Rise by Drawing Water from the Kanawha. Thomas E. Jeffries. Describes a method of manoeuvering the movable dams on the Kanawha as splash dams. Ills. 1500 w. Eng Rec—Jan. 28, 1911. No. 20653.

Puddle Walls for Eastern Dams With a Short Discussion of Other Cores. W. D'Rohan. Gives opinions of various engineers, both in England and America. 4500 w Engng-Con—Jan. 18, 1911. No. 20284.

Design and Construction of the Dam at St. Andrew's Rapids, Manitoba. A. H. Harkness. Illustrated description of a movable dam, of the type known as the Camere, the construction of which gave Winnipeg water communication with the lake. 3500 w. Can Engr—Jan. 26, 1911. No. 20666.

Methods of Constructing a Storage Reservoir Dam at Aziscohos Falls of the Androscoggin River. Seth A. Moulton. From a paper before the Nat. Assn. of Cement Users. Illustrates and describes work in connection with this water storage system in Maine. 6000 w. Engng-Con—Jan. 4, 1911. No. 20060.

The Construction of the Roosevelt Dam. Chester Wason Smith. An illustrated account of the difficulties encountered in constructing a high masonry dam in Arizona. 5500 w. Eng Rec—Dec. 31, 1910. No. 19867.

New Water Supply for Auckland, New Zealand. Illustrated description of the great concrete dam constructed in connection with the work of furnishing an additional water supply; with mention of other features of the work. 2800 w. Engr, Lond—Dec. 30, 1910. No. 20095 A.

Filtration.

Double Filtration of Water. H. W. Clark. Gives results of experimental investigations. 2500 w. Jour N Eng W-Wks Assn—Dec., 1910. No. 20565 F.

The New Mechanical Filtration Plant at Bangor. Illustrated description of a new plant of improved design for purification of the Penobscot River water, which is a difficult problem. 2500 w. Eng Rec—Jan. 21, 1911. No. 20337.

Irrigation.

Elementary Principles of Irrigation—Lateral Construction. F. W. Hanna. Discusses lateral cross-sections, drops, tap boxes, weir crests, checks, lateral banks, water losses, etc. 3500 w. Eng News—Jan. 26, 1911. No. 20616.

Meters.

Are Water Meters Advantageous or Otherwise? Edward W. Bemis. Discusses their advantages and the objections. 3500 w. Eng Rec—Jan. 28, 1911. No. 20650.

See also same title, under MECHANICAL ENGINEERING, MEASUREMENT.

Ohio River.

See Pollution, under WATER SUPPLY.

Pipe Corrosion.

The Corrosive Action of Water on Metals. Robert Spurr Weston. Discusses causes, effects and remedies. General discussion. 6000 w. Jour N Eng W-Wks Assn—Dec., 1910. No. 20563 F.

Pipe Sizes.

Deduction of a General Formula for Determining the Most Economic Size of Pipe to Carry Pumped Water. Also editorial. Shows a simple rule closely applicable under wide variations of pipe, fuel and pump costs. 4000 w. Engng-Con—Jan. 25, 1911. No. 20613.

Piping.

Steel Pipes for Water Works. E. Kuichling. Gives much information in regard to materials used for water pipes, difference in corrosion, protective castings and related subjects. Discussion. 18500 w. Jour N Eng W-Wks Assn—Dec., 1910. No. 20562 F.

Pollution.

Our Typhoid Streams. H. de B. Parsons. A discussion of the pollution of streams and the handling of sewage. 2500 w. Stevens' Ind—Jan., 1911. No. 20314 D.

A Health Department Report on the Upper Ohio River. Considers the Ohio River water in Pennsylvania, unsafe for human consumption unless purified. 2000 w. Eng Rec—Jan. 7, 1911. No. 20005.

Sanitary Survey of the Ohio River in Pennsylvania. Samuel G. Dixon, and F. Herbert Snow. Slightly condensed from conclusion of a report to the Joint Ohio River Sanitary Commission. 3500 w. Eng News—Jan. 5, 1911. No. 19940.

Purification.

Purification of Water Supply. Discusses methods available and where each is most effective. Ills. 3500 w. Munic Jour & Engr—Jan. 4, 1911. No. 20014.

The Purification Plant of the Rochester and Lake Ontario Water Company, Rochester, N. Y. James M. Caird. Detailed description with general discussion. 4000 w. Jour N Eng W-Wks Assn—Dec., 1910. No. 20561 F.

Water Purification Plant, Washington, D. C. Results of Operation. E. D. Hardy. Gives a general description of the plant and a review of the results of five years operation. Ills. 10000 w. Pro Am Soc of Civ Engrs—Dec., 1910. No. 20550 F.

Methods and Costs of Construction of the Slow Sand Purification Works for the New Springfield, Mass., Water Supply. Charles R. Gow. Illustrates and describes in detail the methods and costs of constructing the works comprising this plant, explaining conditions and results. Discussion. 32600 w. Jour Assn of Engng Socs—Dec., 1910. No. 20548 C.

Water Purification and Sanitation at Panama. Information from a paper by John R. Downes, read before the Canal Zone Medical Soc., showing how troublesome the problems have been. 2500 w. Eng Rec—Jan. 14, 1911. No. 20185.

Purification of the Water Supply of Indian Collieries. H. C. H. Shenton. Considers methods of sterilization and their application to suit the conditions in each case. 2500 w. Col Guard—Dec. 23, 1910. No. 19970 A.

Rates.

The Method of Making Water Rates Ordered in Wisconsin. An account of the investigation and rate schedule ordered by the State Railroad Commission for Madison, Wis. 3000 w. Eng Rec—Jan. 7, 1911. No. 20011.

Reservoirs.

Cobb's Hill Reservoir, Rochester, N. Y. John F. Skinner. Illustrated detailed description. 2000 w. Jour N Eng W-Wks Assn—Dec., 1910. No. 20560 F.

The New Central Reservoir of the People's Water Company, Oakland, Cal. C. H. Park, and G. S. Jacobs. Illustrated description of a recently completed concrete lined distributing and equalizing reservoir of 150,000,000 gals. capacity. 1200 w. Eng News—Jan. 5, 1911. No. 19938.

See also Silting, under WATERWAYS AND HARBORS.

Rochester, N. Y.

Memoranda Relative to the City of Rochester. Edwin A. Fisher. Information concerning the sewerage, pavements, water works, city government, etc. 3000 w. Jour N Eng W-Wks Assn—Dec., 1910. No. 20558 F.

See also Water Works, under WATER SUPPLY.

Softening.

See Water Works, under WATER SUPPLY.

Tanks.

Elevated Tank of 200,000 Gallons Capacity, St. Louis, Mo. Illustrated description of a structure recently erected at the Insane Asylum. 1000 w. Eng News—Jan. 19, 1911. No. 20285.

Waste Detection.

Recent Waste Detection and Meter Work in the New York City Water Department. Edward W. Bemis. Describes waste detection and meter work during 1910. Also editorial. 6500 w. Eng News—Jan. 12, 1911. No. 20139.

Water Works.

Water-Works Statistics for the Year 1909, in Form Adopted by the New England Water-Works Association. Computed by Richard K. Hale. 5 tables. Jour N Eng W-Wks Assn—Dec., 1910. No. 20556 F.

Some Water-Works Statistics and Typical Data Showing Rate of Acquisition of Income for Domestic Service by Different Classes of Residential Property. Frank C. Jordan. Also discussion. 9500 w. Jour N Eng W-Wks Assn—Dec., 1910. No. 20566 F.

I. A Rambling Description of the Rochester Water Works. Beekman C. Little. II. Pertinent Matters Relating to the Rochester Water Works. Frederick T. Elwood. 5000 w. Jour N Eng W-Wks Assn—Dec., 1910. No. 20559 F.

The Water-Works and Sewerage of Monterrey, N. L., Mexico. George Robert Graham Conway. Maps and illustrated detailed description of these works, and of conditions and the geology of the country. 21500 w. Pro Am Soc of Civ Engrs—Dec., 1910. No. 20551 F.

Winnipeg's Water-Works. Describes an artesian supply for a population of 175,000. Ills. 4500 w. Can Engr—Jan. 19, 1911. No. 20380.

The Wellingborough Water-Works and Softening Plant. E. Young Harrison. Brief description of the working of the softening plant. Also discussion. 5500 w. Surveyor—Dec. 23, 1910. No. 19966 A.

Water-Works Depreciation.

Depreciation,—In Water-Works Operation and Accounting. Leonard Metcalf. Discusses methods of computing depreciation fund, approximate life renewals, etc. General discussion. 10500 w. Jour N Eng W-Wks Assn—Dec., 1910. No. 20557 F.

Water-Works Management.

Some Comments Upon Water-Works Management Suggested by the Recent Special Reports of the United States Commerce and Labor Department. Leonard Metcalf. Read before the Penn. W-Wks. Assn. 2500 w. Can Engr—Dec. 29, 1910. No. 19851.

WATERWAYS AND HARBORS.

Barge Canal.

The Situation Presented by the Constitutional and Statutory Provisions Governing the New York State Barge Canal Work and Character of Work Up to Date. Condensed reports of F. C. Stevens, Supt. of Public Works and of the Board of Advisory Consulting Engineers, with editorial. 9500 w. Engng-Con—Jan. 11, 1911. No. 20122.

Canals.

The Cape Cod Canal. R. P. Getty. An illustrated account of this new waterway—a sea-level canal 12 miles long—explaining its importance and describing the present progress of the work. 3500 w. Cassier's Mag—Jan., 1911. No. 20302 B.

The Brussels Ship Canal (Le Canal Maritime de Bruxelles). Brief description of the Willebroeck Canal and the harbor works at Brussels, and the project for making the canal available for large ships. Ills. 4800 w. Tech Mod—Dec., 1910. No. 20415 D.

Economic Importance of the Canalization of the Mosel (Die volks- und weltwirtschaftliche Bedeutung der Moselkanalisierung). Hermann Schumacher. Discusses its importance for the commerce of Germany and of the world. 10000 w. Tech u Wirt—Dec., 1910. No. 20711 D.

See also Silting, under WATERWAYS AND HARBORS.

Colorado River.

The U. S. Government Work on the Colorado River Break. Map and account of a break in 1909 and 1910, and the plans for restoring the river to its former bed and preventing future breaks. 500 w. Eng News—Jan. 26, 1911. No. 20617.

Dredges.

See same title, under MARINE AND NAVAL ENGINEERING.

Dredging.

A Plant for Removing Boulders from Dredging Spoil. Illustrated description of a plant used in connection with the Barge Canal work. 1500 w. Eng Rec—Jan. 28, 1911. No. 20652.

Dry Docks.

New French Dreadnought Dry Docks. Illustrations and information in regard to the new docks at St. Nazaire and Bordeaux. 1000 w. Engr, Lond—Jan. 6, 1911. No. 20269 A.

A 22000-Ton Floating Dry Dock for Brazil. Illustrated detailed description of a dry dock built in England and towed to Brazil. 7000 w. Int Marine Engng—Jan., 1911. No. 19924 C.

Floods.

The Menace of Danube Floods in Vienna (Wien von den Hochfluten der Donau dauernd bedroht). Anton Waldvogel. A long exposition of the danger, with a discussion on a previous paper on methods of protection. Ills. 1200 w. Zeitschr d Oest Ing u Arch Ver—Dec. 23, 1910. No. 20482 D.

Ice.

Ice Formation. H. T. Barnes. Brief account of the main results of a study of ice conditions on the St. Lawrence River. 3000 w. Jour N Eng W-Wks Assn—Dec., 1910. No. 20564 F.

Lighthouses.

A New Automatic Flashing Light. Illustrated description of an apparatus for producing a flashing light and requiring attention at protracted intervals. 1600 w. Engr, Lond—Dec. 23, 1910. No. 19980 A.

Locks.

Methods of Constructing the Black Rock Harbor Lock; New York State Barge Canal. Illustrated detailed description of the cofferdam and lock construction at Buffalo, N. Y. 2000 w. Engng-Con—Jan. 4, 1911. No. 20057.

See also Excavation, under CONSTRUCTION.

Manzanillo.

The Port of Manzanillo. Harry H. Dunn. An illustrated description of harbor improvements on the Pacific coast of Mexico. 3000 w. Cassier's Mag—Jan., 1911. No. 20307 B.

Panama Canal.

The Panama Canal. Discussion held at the sessions of the Canal Zone meeting, November, 1910. 38500 w. Bul Am Inst of Min Engrs—Jan., 1911. No. 20583 F.

A Report by a Geologist on Slides in Culebra Cut and by a Board of Engineers on the Revetment of the Sides of the Cut. The major part of these two reports with editorial. 3000 w. Eng News—Jan. 5, 1911. No. 19939.

See also Excavation. under CONSTRUCTION.

Shore Protection.

Methods of Shore Protection on the Sea Coast and on Canals (Uferbefestigungen an der Meeresküste and an Kanälen). Jonkheer Robert de Muralt. A review of practice in Holland. Ills. 3800 w. Zeitschr d Oest Ing u Arch Ver—Dec. 9, 1910. No. 20480 D.

Silting.

The Silting Up of Reservoirs and Canals and Some Methods for Preventing Same. W. D'Rohan. Considers appliances to cleanse reservoirs from silt after it is deposited, and devices to prevent silt from entering reservoirs. Ills. 4000 w. Engng-Con—Jan. 11. 1911. No. 20121.

Sluice Gates.

An Automatic Sluice Gate to Ensure Constant Water Level. E. Lauchli. Brief description with illustrations. 500 w. Eng News—Dec. 29. 1910. No. 19793.

Submarine Excavation.

The Operation of Rock Breakers at Black Rock Harbor. Illustrates and describes the use of the Lobnitz rock breakers in harbor improvement work at Buffalo, N. Y. 3500 w. Eng Rec—Jan. 7, 1911. No. 20001.

United States Waterways.

Waterways: Their Limitations and Possibilities. Frederic A. Delano. Extracts from a paper read before the Nat. Rivers & Harbors Cong. A critical discussion of cost and economy in relation to inland water transportation, especially the waterway from the Lakes to the Gulf. 2000 w. Eng News—Dec. 29. 1910. No. 19845.

The Relation of the Corps of Engineer Officers, U. S A., to River and Harbor Improvements, Gen. W. H. Bixby. From an address before the Nat. Rivers & Harbors Cong. Remarks on the education of engineer officers, and on river and harbor work. Considers depth of channel of secondary importance. 4500 w. Eng News—Dec. 29, 1910. No. 19796.

The Illinois Waterway. Robert Isham Randolph. Favorable to the construction of this waterway to connect the Great Lakes and the Mississippi River. 4500 w. Jour Am Soc of Engng Contractors—Oct., 1910. No. 20527 N.

Water Powers.

Utilization of the Water Powers of the Austrian Alps (Die Ausnutzung der Wasserkräfte in den österreichischen Alpenländern). H. Düll. This part discusses projects in northern Tyrol. Ills. Serial. 1st part. 3200 w. Elektrotech u Maschinenbau—Dec. 18, 1910. No. 20700 D.

Wave Action.

A Theory of the Water Wave. Morton F. Sanborn. Gives conclusions based on a study of the vertical circulation of water. 7000 w. Pro Am Soc of Civ Engrs—Dec. 1910. No. 20552 F.

MISCELLANY.

Aesthetics.

Art and the Engineer. James P. Haney. Lecture before the Stevens Engng Soc. On the value of beauty in engineering work. The true meaning of art and its applications. 2500 w. Stevens' Ind—Jan., 1911. No. 20316 D.

Explosions.

The Disastrous Explosion at Jersey City, N. J., on Feb. 1, 1911. An illustrated account of the dynamite explosion and its effects. 600 w. Eng News—Feb. 9, 1911. No. 20917.

Military Engineering.

Military Engineering. C. W. Otwell. Considers the engineering work for which engineers of the army must be fitted. Ills. 14000 w. Pro Engrs' Club of Phila—Jan., 1911. No. 20577 D.

Philippines.

Philippine Public Works. Information from the annual report concerning work carried out during the year ending June 30, 1910. Ills. 1500 w. Far East Rev—Dec., 1910. No. 20887 N.

Rock Crushing.

A Rock Crushing and Storage Plant at Tomkins Cove, N. Y. Illustrated description of a plant having a crushing and screening capacity of 1000 yds. per hour of commercial sizes of product. 4500 w. Eng Rec—Jan. 7, 1911. No. 20003.

The New Stone Crushing Plant of the Tomkins Cove Stone Co., Tomkins Cove. N. Y. Illustrated description of plant and equipment for the economical production of crushed stone. Also editorial. 5500 w. Eng News—Jan. 12, 1911. No. 20137.

ELECTRICAL ENGINEERING

COMMUNICATION.

Condensers.

Mica Condensers as Standards of Capacity. Harvey L. Curtis. Research work made to determine to what extent a mica condenser can be considered a satisfactory standard of capacity. 12600 w. Bul Bureau of Stand—Nov., 1910. No. 20540 N.

Radiotelegraphy.

Notes on the Oscillation Transformer. John Stone Stone. Mathematical determination of the constants of oscillation transformers used in wireless telegraphy. 1000 w. Elec Wld—Jan. 19, 1911. No. 20296.

The Comparative Sensitiveness of Some Common Detectors of Electrical Oscillations. Louis W. Austin. Describes some experimental comparisons of the sensitiveness of wireless detectors. Ills. 3000 w. Bul Bureau of Stand—Nov., 1910. No. 20543 N.

The Theory and Practice of Wireless Detectors as at Present Used. S. M. Powell. The present article considers methods of testing detectors, connection of detectors, and types. 2000 w. Elec Rev, Lond—Jan. 6, 1911. Serial. 1st part. No. 20246 A.

Wireless Communication from Air Ships. A. Frederick Collins. Illustrates and describes the apparatus used in the dirigible balloon "America.' 2000 w. Cassier's Mag—Jan., 1911. No. 20304 B.

Transmission of Time Signals by Wireless (Transmission de l'Heure par le Télégraphie sans Fil). M. Béache. Describes practice in Europe, particularly at the Eiffel Tower in Paris. Ills. 1600 w. Génie Civil—Dec. 10, 1910. No. 20427 D.

Radiotelephony.

Dubilier's New Commercial Wireless Telephone. C. O. White. Illustrated description. 1800 w. Elect'n, Lond—Dec. 30, 1910. No. 20082 A.

Telephone Cables.

The Cuntz Electric Cable. Brief description of an invention of J. H. Cuntz in which the retarding and distorting effects are overcome by means of distributed conductance. Ills. 500 w. Stevens' Ind—Jan., 1911. No. 20317 D.

Telephone Law.

Public Telephone Service (La Servitu delle Condutture telefoniche). F. Agnello. A digest and discussion of Italian telephone law. Serial. 1st part. 3900 w. Ann d Soc d Ing e d Arch Ital—Nov. 1. 1910. No. 20438 F.

Telephone Systems.

Telephone Service in Chicago. Alfred U. Hoefer. Brief account of the service of a very large system. Ills. 1000 w. Wis Engr—Jan., 1911. No. 20327 C.

Telephony.

A System of Multiplex Telephony. Illustrated description of the multiplex signaling system invented by Major George Owen Squier. Ills. 1500 w. Elec Rev & W Elect'n—Jan. 14, 1911. No. 20200.

Long-Distance Telephony. J. J. Carty. From the *Nat. Tel. Jour.* A statement with respect to the condition of long distance telephony in the United States. 3000 w. Elec Rev & W Elect'n—Jan. 28, 1911. No. 20661.

DISTRIBUTION.

Wiring.

Wiring of a New York Loft Building. John P. Morrissey. Illustrated description of the wiring of a 19-story building in which the electrical equipment is of the highest grade. 2500 w. Elec Wld—Jan. 26, 1911. No. 20636.

DYNAMOS AND MOTORS.

A. C. Generators.

A Generator with Variable Number of Poles (Ein polumschaltbarer Generator). F. Niethammer and E. Siegel. Reports tests of such a generator designed for varying the frequency of a transmission system with induction motor loads. Ills. 2500 w. Elektrotech u Maschinenbau—Dec. 4, 1910. No. 20496 D.

Commutation.

Commutation Phenomena in D. C. Machines. G. W. Worrall. Rewritten from paper before the Inst. of Elec. Engrs. Discusses the requirements of the well-designed brush holder, and the carbon brush, and considers the electrical and magnetic phenomena in commutation. Ills. 2500 w. Mech Engr—Jan. 6, 1911. No. 20251 A.

What Is a Commutator? George S. Hodgins. Explains this device for converting an alternating current into a continuous one. Ills. 1000 w. Ry & Loc Engng—Jan., 1911. No. 20019 C.

Design.

Examples in Dynamo Design. Explains the physical basis of the relationships which enter into the calculations, and gives examples of the connections proved by practice to be necessary to produce efficient results, explaining how the determinations may be made. 1200 w. Mech Wld—Jan. 6, 1911. Serial. 1st part. No. 20254 A.

Flame-Proof Heaters.

See Electric Power, under MINING AND METALLURGY, Coal and Coke.

Induction Motors.

Probable Developments of Asyuchronous Motors. J. Fischer-Hinnen. Abstract of an article in *Elektrotechnische Zeit.*

Explains a method, described in one of the Oerlikon Co.'s patents, for reducing the starting current. Ills. 1600 w. Elect'n, Lond—Dec. 30, 1910. No. 20079 A.

The Circle Diagram of the Polyphase Induction Motor (Das Kreisdiagramm des mehrphasigen Asynchrommotors). Karl Krug. Mathematical. Ills. 4200 w. Electrotech u Maschinenbau—Dec. 4, 1910. No. 20495 D.

Starters.

A Simple Method of Determining the Number of Steps for Shunt-Wound Motor and Rotor Starters (Ein einfaches Hilfsmittel zur Bestimmung der Stufen von Anlassern für Nebenschlussmotoren und Rotoranlassern). Hans Zallud. Ills. 1800 w. Elektrotech u Maschinenbau—Dec. 25, 1910. No. 20701 D.

ELECTRO-CHEMISTRY.

Calcium Cyanamid.

What Is "Cyanamid?" John Woods Beckman. An explanation of three different substances that go under this name. 1000 w. Met & Chem Engng—Jan., 1911. No. 20124 C.

Electric Furnaces.

Electric Furnaces. Carl Hering. Reviews the rapid development and discusses the commercial importance. 3000 w. Elec Rev & W Elect'n—Jan. 7, 1911. No. 20051.

Thermal Resistance and Conductance; the Thermal Ohm and Thermal Mho. Carl Hering. Urges that a name be given to the unit of thermal resistance, suggesting the "thermal ohm" for thermal resistances, and "thermal mho" for thermal conductances, and giving a table of conversion factors. 2500 w. Met & Chem Engng—Jan., 1911. No. 20125 C.

The Reliability of Electric Furnaces. F. T. Snyder. Read before the Chicago Soc. of the Am. Elec-Chem. Soc. Discusses factors in the development under American conditions. 2500 w. Ir Age—Jan. 26, 1911. No. 20599.

Electric Induction Furnaces (Forni elettrici ad Induzione). Remo Catani. A comprehensive review of the various types and their applications. Ills. Serial. 1st part. 2400 w. Industria—Dec. 4, 1910. No. 20441 D.

A New Form of Electrode. A. Mahlke. Suggests an arrangement for securing the same current density throughout an electric furnace. Ills. 500 w. Met & Chem Engng—Jan., 1911. No. 20132 C.

A New Electric Furnaces for Steel Melting and Refining. Joh. Härdén. Illustrated description of a combined arc and resistance furnace known as the "paragon." 1000 w. Met & Chem Engng—Jan., 1911. No. 20130 C.

Electrochemistry.

What Electrochemistry Is Accomplishing. Joseph W. Richards. Address before the Am. Elecchem. Soc. Discusses modern methods and results in industrial processes. 3500 w. Sci Am Sup—Jan. 28, 1911. Serial. 1st part. No. 20638.

Electrometallurgy.

Present Status of Electrometallurgy (Lo Stato attuale dell' Elettrometallurgia). Gino Gallo. A review of furnaces and processes, discussing principally iron metallurgy but including reference to all the non-ferrous metals. Ills. 10800 w. Ann d Soc d Ing e d Arch Ital—Nov. 15, 1910. No. 20439 F.

Electroplating.

A Review of the Nickel Plating Industry. Charles H. Buchanan. Historical review of practice from the early 70's. 1700 w. Brass Wld—Jan., 1911. No. 20300.

A Simple Method of Recovering Silver from Silver Plating Solutions. Describes a method requiring no special apparatus, and entirely free from danger as the cyanide is not decomposed. 1500 w. Brass Wld—Jan., 1911. No. 20299.

ELECTRO-PHYSICS.

Circuits.

Unusual Current Relations in Condensive and Inductive Circuits. Alfred Still. Explanation of some results obtained under actual working conditions. 1000 w. Elec Wld—Jan. 26, 1911. No. 20634.

Conductors.

The Stretching of a Conductor by Its Current. Carl Hering. Gives certain reasons which tend to show that a force lengthwise to a conductor ought to be produced by the current flowing through it; and describes experiments which show that such a force exists. Ills. 4000 w. Jour Fr Inst—Jan., 1911. No. 20322 D.

Hysteresis.

Magnetic Hysteresis at the Temperature of Liquid Air. R. Beattie and H. Gerrard. Experiments are described showing the effect of temperature on both "rotational" and "alternational" hysteresis in iron, steel, nickel, and cobalt. Liquid air was used for producing the low temperatures required. 2500 w. Elect'n, Lond—Dec. 23, 1910. No. 19961 A.

Hysteresis and Eddy Current Exponents for Silicon Steel. W. J. Wooldridge. Shows apparent changes in general direction of curves required for predetermining core losses of apparatus in which silicon steel is used. 600 w. Pro Am Inst of Elec Engrs—Jan., 1911. No. 20589 F.

Inductance.

The Mutual Inductance of Two Parallel Coaxial Circles in Terms of Hypergeometrical Series. Frederick W. Grover. Mathematical. 2000 w. Bul Bureau of Stand—Nov., 1910. No. 20541 N.

Induction.

A Research for a Simple Theory of Self Induction (Versuch einer Elementartheorie der Selbstinduktion). Hans Neubauer. Derives a theory of self induction from elementary principles. Ills. Serial. 1st part. 2400 w. Oest Zeitschr f Berg u Hüttenwesen—Dec. 3, 1910. No. 20450 D.

Magnetic Properties.

The Magnetic Properties of Iron Alloys and Their Uses in Alternate-Current Design. Dr. S. Guggenheim. Abstract of lecture before the Phys. Gesell. Describes experiments on a series of alloys of silicon and iron. 1500 w. Elect'n, Lond—Jan. 13, 1911. No. 20501 A.

Magnetism.

Mechanical Forces in Magnetic Fields. Charles P. Steinmetz. Gives a general study of these forces. Also a more accurate design of the electromagnet which permits the determination of its efficiency. 2500 w. Pro Am Inst of Elec Engrs—Dec., 1910. No. 19710 F.

A Study of Unbalanced Magnetic Pull. Charles R. Moore. Gives a method, more or less graphical, for studying magnetic pull, which does not require higher mathematics. Ills. 2500 w. Elec Rev & W Elect'n—Jan. 14, 1911. No. 20198.

Magnetomotive Force in Non-Uniform Magnetic Paths: A. Miller Gray. Solves the problem of calculating the ampere-turns necessary to send a given flux through the teeth of a d. c. machine. Also editorial. 1200 w. Elec Wld—Jan. 12, 1911. No. 20136.

Mechanical Analogies.

Mechanical and Electrical Analogies (Mechanisch-elektrische Analogien). K. Wessely. Discusses mechanical analogies with certain phenomena of transformer and generator working. Mathematical. Ills. 3500 w. Elektrotech u Maschinenbau—Dec. 18, 1910. No. 20499 D.

Oscillations.

Resonance without Damping (Resonanz ohne Dämpfung). Fritz Emde. Mathematical discussion of the effect on undamped oscillations of resonance with and external periodic force. Ills. 2200 w. Elektrotech u Maschinenbau—Dec. 25, 1910. No. 20702 D.

Radioactivity.

Radioactivity. Madame P. Curie. Introduction to a forthcoming book, giving a résumé of our present knowledge. 2500 w. Sci Am Sup—Dec. 31, 1910. No. 19789.

GENERATING STATIONS.

Accumulators.

Thomas A. Edison's Latest Invention. Joseph B. Baker. Illustrated description of the new battery. 3000 w. Sci Am—Jan. 14, 1911. No. 20166.

Envelope or Thin Plates for Storage Batteries. Stockton H. Mortimer. Discusses the characteristic features of these two types. 1200 w. Elec Wld—Jan. 10, 1911. No. 20297.

The Capacity and Efficiency of Storage Batteries. W. M. MacLeod. Discusses the eccentricities of storage batteries, giving data for design and discussing capacity, efficiency, etc. 2500 w. Sib Jour of Engng—Dec., 1910. No. 20335 C.

See also Substations, under TRANSMISSION.

Central Stations.

Quarry Street Station Completed. Illustrated detailed description of the latest generating plant of the Commonwealth Edison Company, in Chicago, with continuous rating of 84000 kw. 5500 w. Elec Wld—Jan. 5, 1911. No. 20115.

The Vendin-le-Vieil Generating Plant (Usine génératrice de Vendin-le-Vieil). Describes a plant designed to utilize coke-oven gas from the Lens collieries. Ills. 2600 w. L'Elecn—Dec. 31, 1910. No. 20421 D.

Hydro-Electric.

Hydro-Electric Practice. H. A. von Schon. Considers the principles of design of hydro-electric plants. 2500 w. Munic Engng—Jan., 1911. No. 20331 C.

The Ontario Hydroelectric System. Illustrated detailed description of the generation, transmission and distribution of electrical energy in Ontario. 4500 w. Elec Rev and W Elect'n—Dec. 31, 1910. No. 19859.

Electricity from a Drainage Canal. First part of an illustrated report on the hydroelectric development of the Chicago Drainage Canal. Also editorial. 4000 w. Elec Wld—Jan. 12, 1911. Serial. 1st part. No. 20135.

The Menominee & Marinette Hydro-Electric Development. Illustrated detailed description of a development on the Menominee River to supply these cities of Wis. and Mich. with electricity for light, power and street railway service. 2000 w. Eng Rec—Jan. 14, 1911. No. 20176.

Hydroelectric Power at Wausau, Wis. D. B. Hanson. Brief illustrated description of three small plants drawing their power from the Wisconsin River. 1600 w. Power—Jan. 24, 1911. No. 20389.

The Hydro-Electric Nitrogen Works at Notodden, Norway. Abstract from *Teknisk Ugeblad.* Illustrated detailed description. 2500 w. Elec Rev, Lond—Dec. 30, 1910. No. 20078 A.

The Hydroelectric Plant at Madières. C. L. Durand. Illustrated description of a generating plant on the Vis River in France. 1400 w. Elec Rev & W Elect'n—Jan. 14, 1911. No. 20197.

The Ventavon Hydro-Electric Plant on the Durance (Usine Hydro-Electrique de Ventavon sur la Durance, Hautes-Alpes). Ch. Dantin. Describes the main features of this 28,000 horse-power development. Ills. 4000 w. Génie Civil—Dec. 31, 1910. No. 20435 D.

The Lagastrello Hydro-Electric Plant (L'Impianto idro-elettrica del Lagastrello della Societa idro-elettrica Ligure). Brief description of a plant supplying power to Isola, Italy. 2200 w. Monit-Tech—Dec. 10, 1910. No. 20440 D.

See also Lines, under TRANSMISSION; Water Powers, under CIVIL ENGINEERING, WATERWAYS AND HARBORS.

Isolated Plants.

Power Plant of the Raike Building. Osborn Monnett. Illustrates and describes a plant of 160 kw. Capacity furnishing electric power to manufacturing works in the building. 1200 w. Power—Jan. 10, 1911. No. 20101.

Electricity in a Huge Mail Order Establishment. Illustrated description of the installation at the Chicago plant of Sears, Roebuck & Company. 2500 w. Elec Rev & W Elect'n—Jan. 28, 1911. No. 20659.

Switchgear.

Switchgear and the Isolation of Faults on Power Supply Systems. H. W. Clothier. Read before the Newcastle Loc. Sec. of the Inst. of Elec. Engrs. Considers the essentials of a large power supply undertaking, and the systems of protection. Ills. Discussion. 10800 w. Elec Engr, Lond—Dec. 30, 1910. No. 20077 A.

LIGHTING.

Coal Mines.

See Mine Lighting, under MINING AND METALLURGY, COAL AND COKE.

Illumination.

The New Era in Electrical Illumination. Rollin W. Hutchinson, Jr. Third and last article of a series, dealing with glower and vapor lamps and their characteristics. Ills. 2500 w. Engineering Magazine—Feb., 1911. No. 20679 B.

Reflection Co-efficients. Paul F. Bauder. Abstract of a paper before the N. Y. Sec. of Ill. Engng. Soc. Discusses the importance of reflection and absorption in interior illumination. 3000 w. Elec Rev & W Elect'n—Jan. 28, 1911. No. 20660.

The Illumination of Interiors. J. T. Morris. Aims to correct some mistaken ideas which prevail. The present number discusses daylight illumination. 1500 w. Archt, Lond—Jan. 6, 1911. Serial. 1st part. No. 20241 A.

Incandescent Lamps.

Incandescent Lamps in 1910. Charles F. Scott. A review of progress in the manufacture and applications. 1000 w. Elec Rev & W Elect'n—Jan. 7, 1911. No. 20050.

Recent Progress in Electric Lighting. E. W. Marchant. Abstract of paper read before the Ill. Engng. Soc. Considers recent developments in incandescent lamps and gives particulars of experiments on the effect of repeated switching on and off of metal lamps, the effect of vibration, life of lamps, etc. Distribution is discussed and arc lamp progress and vapor lamps. Discussion. 5500 w. Elect'n, Lond—Dec. 23, 1910. No. 19960 A.

The Effect of Wave Form Upon Incandescent Lamps. Morton G. Lloyd. Read before the Am. Phys. Soc. & Am. Assn. for the Adv. of Sci. An investigation to determine the effect upon candle power and upon life of lamps. Mathematical. 2500 w. Elec Rev & W Elect'n—Jan. 14, 1911. No. 20199.

Photometry.

Photometric Units and Nomenclature. Edward B. Rosa. A systematic discussion of the mathematical and physical relationships of the various protometric quantities. 6000 w. Bul Bureau of Stand—Nov., 1910. No. 20544 N.

Progress.

The Lighting Situation. Louis Bell. A review of progress during the past year. 1800 w. Elec Rev & W Elect'n—Jan. 7, 1911. No. 20049.

Street.

Intense Street Lighting. Alton D. Adams. Discusses illumination with tungsten incandescent and flaming arc lamps, comparing with carbon arcs, and criticizing methods. 2000 w. Munic Jour & Engr—Jan. 11, 1911. No. 20143.

Public Lighting in the City of London. Illustrated review of the history of street lighting by electricity in London. 2500 w. Elec Rev, Lond—Dec. 23, 1910. Serial. 1st part. No. 19957 A.

The Use of Reflectors in Street Lighting (Emploi de Réflecteurs économiseurs pour l'Eclairage des Voies publiques). A. Grebel. Discusses the curves of distribution of various light sources, and available economizing reflectors. Ills. 3200 w. Génie Civil—Dec. 17, 1910. No. 20429 D.

Vacuum Tubes.

Temperature and Potential-Pressure Relations in the Mercury Arc. C. T. Knipp. Abstract of an article in the *Phys. Rev.* Investigates the temperature of the mercury arc by means of a thermo-junction for pressures up to 3 mm. of mercury at a constant current of 3 amperes. 1500 w. Elect'n, Lond—Dec. 30, 1910. No. 20080 A.

MEASUREMENT.

Electrodynamometers.

A New Method for the Absolute Measurement of Electric Quantity. Burton McCollum. Describes a type of electrodynamometer which appears to be free from the objections to the ordinary types, and it is believed no serious difficulties are introduced. 6000 w. Bul Bureau of Stand—Nov., 1910. No. 20542 N.

Laboratories.

The Electrical Testing Laboratory at the Berlin Technical High School (Das

Elektrotechnische Versuchsfeld der Technischen Hochschule zu Berlin). W. Reichel and M. Gerstmeyer. Describes the laboratory arrangement and equipment. Ills. Serial. 1st part. 3200 w. Zeitschr d Ver Deutscher Ing—Dec. 17, 1910. No. 20707 D.

Meters.

Electricity Recording Meters. W. H. Alabaster and N. A. Wheaton. Considers the construction and general performance of types employed at the Melbourne City Council's plant. 1200 w. Aust Min Stand —Nov. 30, 1910. Serial. 1st part. No. 20071 B.

Oscillographs.

The Testing of Oscillographs (Theoretisches zur Prüfung von Oszillographen). Fritz Emde. A technical discussion of the testing of oscillographs with reference to their inertia and damping effect. Ills. 2800 w. Elektrotech u Maschinenbau—Dec. 11, 1910. No. 20497 D.

Phasemeters.

A New Model of the Hartmann and Braun Phasemeter (Phasemètre Hartmann et Braun, Nouveau Modèle). M. Aliamet. Describes improvements introduced in this device by Dr. Bruger. Ills. 1500 w. L'Elecn—Dec. 31, 1910. No. 20420 D.

TRANSMISSION.

Balancers.

The Theory of the Static Balancer. C. C. Hawkins. Considers the simple two-phase case when the third wire is disconnected from the balancer, and when connected. 2000 w. Elect'n, Lond—Jan. 13, 1911. No. 20503 A.

Cables.

See Electric Power, under MINING AND METALLURGY, COAL AND COKE.

Fault Isolation.

See Switchgear, under GENERATING STATIONS.

Insulators.

Open Atmosphere and Dry Transformer Oil as High-Voltage Insulators. Harris J. Ryan. Report of high-voltage line tests, discussing the high-tension transmission corona problem. Ills. 23000 w. Pro Am Inst of Elec Engrs—Jan., 1911. No. 20584 F.

Line Construction.

Construction of a Transmission Line in Arizona. Illustrated description of the towers and poles and general construction work. 2000 w. Eng Rec—Jan. 28, 1911. No. 20651.

Line Design.

Design, Construction and Test of an Artificial Transmission Line. J. H. Cunningham. A line constructed to investigate and study phenomena in connection with switching, sudden load, etc., is described. Ills. 1800 w. Pro Am Inst of Elec Engrs—Jan. 1911. No. 20586 F.

Line Losses.

Tests of Losses on High Tension Lines. G. Faccioli. Gives results of tests on the lines of the Central Colorado Power Co. Ills. 3800 w. Pro Am Inst of Elec Engrs —Jan., 1911. No. 20587 F.

High Voltage Line Loss Tests Made on the 100-Kilovolt 60-Cycle 180-Mile Transmission Line of the Central Colorado Power Company. E. L. West. Charts. 800 w. Pro Am Inst of Elec Engrs—Jan., 1911. No. 20585 F.

Line Plans.

Network Plans and Diagrams. Charles W. Rycroft. Plans and information from the writer's experience relating to a successful system. 1000 w. Elec Rev, Lond —Jan. 13, 1911. No. 20399.

Lines.

North-East Coast Power Supply. Illustrated description of the transmission and distribution lines to collieries. Map. 6000 w. Elect'n, Lond—Jan. 13, 1911. No. 20500 A.

The 70,000-Volt Installation at Molinar on the Jucar, Spain (Electrische Krachtsoverbrengingen. 70,000 Volt Installatie te Molinar a/d. Jucar in Spanje). J. W. Van Dijk. Describes particularly the high-tension transmission line. Ills. 9800 w. De Ingenieur—Dec. 31, 1910. No. 20713 D.

Line Testing.

See Line Losses, under TRANSMISSION.

Poles.

A Portable Collapsible Mast. Illustrated description of an ingenious German invention. 1000 w. Sci Am—Dec. 31, 1910. No. 19788.

Damage to Chestnut Telephone and Telegraph Poles by Wood-Boring Insects. Thomas E. Snyder. Reports serious damage and investigations resulting in practical methods of preventing injury. Ills. 4000 w. U S Dept of Agri—Bul. 94. Serial. Part I. No. 20676 N.

Protective Devices.

Merz-Price Protective Gear and Other Discriminative Apparatus for A. C. Circuits. K. Faye-Hansen, and G. Harlow. Abstract of a paper before the Manchester Sec. of the Inst. of Elec. Engrs. Descriptive. Short discussion. 1500 w. Elect'n, Lond—Jan. 6, 1911. No. 20247 A.

Regulations.

The French Law of March 21, 1910, and the Regulations of the Union des Syndicats (A Propos de l'Arêté du 21 Mars 1910 et des Instructions de l'Union des Syndicats). Discussion of M. Boucherot's paper. 8800 w. Bul Soc Int d Elecns—Dec., 1910. No. 20402 F.

Rotary Converters.

Discussion on "Interpoles in Synchronous Converters," New York, Nov. 11, 1910. The paper by B. G. Lamme and F. D. Newbury. 9800 w. Pro Am Inst of Elec Engrs—Jan., 1911. No. 20591 F.

Substations.

Storage-Battery Substation for Detroit River Tunnel Electric Railway Installation. Illustrated account of a substation to meet special requirements. 2000 w. Elec Wld—Jan. 26, 1911. No. 20633.

Transformers.

Commercial Problems of Transformer Design. H. R. Wilson. Brief discussion of how best to balance engineering and commercial conditions. 1800 w. Pro Am Inst of Elec Engrs—Jan., 1911. No. 20590 F.

Current-Ratio and Phase-Angle Test of Series Transformers. H. S. Baker. Describes a method for determining the current ratio by opposing the m. m. f. of the primary current to that of the secondary current when the two currents are passed around a special test core. Diagram. 700 w. Elec Wld—Jan. 26, 1911. No. 20635.

The Temperature Gradient in Oil Immersed Transformers. James Murray Weed. An investigation which undertakes, by a study of the laws of cooling, to formulate a correct theory applicable to the general case. 6500 w. Pro Am Inst of Elec Engrs—Jan., 1911. No. 20588 F.

Two-Phase.

Operation of a Two-Phase Distribution System. Alden W. Welch. Explains present practice. 1500 w. Elec Wld—Jan. 5, 1911. No. 20116.

Voltage Regulation.

Single-Phase Feeder Regulators. Edwin E. Lehr. Illustrates and describes regulators of the indication type giving information concerning their use. 4000 w. Elec Rev & W Elect'n—Dec. 31, 1910. No. 19860.

MISCELLANY.

Insulating Materials.

Asphalts and Bitumens in Electrical Work. C. Toone. A sketch of the nature of these materials and their use for insulating. 2000 w. Cassier's Mag—Jan., 1911. No. 20303 B.

Paris Flood.

Electrical Machinery in the Paris Flood of January, 1910 (L'Inondation de Janvier 1910 et le Matériel électrique). M. Guery. Describes the effect of the flooding on electrical apparatus, the damage caused, and the repairs necessary. 8400 w. Bul Soc Int d Elecns—Dec., 1910. No. 20405 F.

Patents.

Review of Electrical Patents of the Year 1910. Edward E. Clement. A review of the past year's work in the line of electrical inventions. 4000 w. Elec Rev & W Elect'n—Jan. 7, 1911. No. 20053.

Review of 1910.

Progress in 1910. Collection of articles by known writers, dealing with notable features and tendencies in their respective lines. 20000 w. Elec Jour—Jan., 1911. No. 20323.

INDUSTRIAL ECONOMY

Accounting.

Orders, Records, Expense Accounts. Holden A. Evans. Outlines a cost system, describing methods. 4000 w. Am Mach—Vol. 33. No. 52. No. 20223.

Expense Accounts and Analysis. Holden A. Evans. Gives an outline of expense schedules and a form of comparative monthly analysis. 4000 w. Am Mach—Jan. 12, 1911. No. 20233.

Apprenticeship.

Educating Apprentices on the Santa Fe. F. W. Thomas. Abstract of paper read at the convention of the Nat. Soc. for the Pro. of Ind. Ed. Describes the school work and shop instruction. 2500 w. Ry Age Gaz—Jan. 6, 1911. No. 20031.

Cost Systems.

Distribution of Indirect Costs. Holden A. Evans. A discussion of methods. 5000 w. Am Mach—Vol. 33. No. 51. No. 20221.

Cost System for Shops of Medium Size. Strickland L. Kneass. Explains a system in use by a manufacturer of brass injectors. 1000 w. Am Mach—Jan. 19, 1911. No. 20370.

Sound Business Methods in the Foundry. Ellsworth M. Taylor. A summary of foundry cost elements with illustrations of their application. 2800 w. Ir Age—Jan. 5, 1911. No. 19922 D.

Education.

New Engineering Laboratory, University of Sydney. Plans, photographs and brief description. 1800 w. Engr, Lond—Jan. 13, 1911. No. 20519 A.

The Training of Chemical Engineers. M. C. Whitaker. Read before the Am. Inst. of Chem. Engrs. Discusses the training needed for the requirements of the chemical industries. 3000 w. Met & Chem Engng—Jan., 1911. No. 20123 C.

The Conference Department at Lehigh University. Dr. Henry S. Drinker. An account of method for assisting deficient scholars in the first two years of the college course. 1500 w. Bul Am Inst of Min Engrs—Jan., 1911. No. 20582 F.

The Continuation Schools of Munich. Dr. Georg Kerschensteiner. Discusses the aims of such schools and the difficulties and methods of overcoming them. 4000 w. Jour Am Soc of Mech Engrs—Jan., 1911. No. 20569 F.

The Formation of the Commercial Engineer (La Formation de l'Ingénieur commercial). Emile Waxweiler. Read at the International Congress on Technical Education. Discusses the planning of courses for education for business careers. 6200 W. Rev de Métal—Dec., 1910. No. 20408 E + F.

Engineers' Licenses.

The Licensing of Engineers; Action of the American Society of Civil Engineers. Also account of the annual meeting, and editorial. A draft of the law prepared by a committee of Am. Soc. of Civ. Engrs. with editorial discussion. 7500 w. Eng News—Jan. 26, 1911. No. 20624.

Industrial Safety.

Industrial Safety (Technik und Versicherung). Alfred Manes. A review of the study of conditions of industrial safety in Germany. 4000 w. Tech u Wirt—Dec., 1910. No. 20712 D.

Labor Agreements.

Collective Bargaining in England (Le Contrat collectif de Travail en Angleterre). Maurice Bellom. A review of a recent Board of Trade report, with reference to its interest for French manufacturers. Ills. Serial. 1st part. 1800 w. Génie Civil—Dec. 24, 1910. No. 20434 D.

Management.

The Twelve Principles of Efficiency. Harrington Emerson. This ninth article of a series considers the seventh principle: dispatching. 3500 w. Engineering Magazine—Feb., 1911. No. 20684 B.

Systematic Foundry Operation and Foundry Costs. C. E. Knoeppel. This fifth article of a series discusses the importance of efficient dispatching in the foundry. 4500 w. Engineering Magazine—Feb., 1911. No. 20682 B.

Standards of Efficiency in Shop Operations. Harrington Emerson. Extracts from an address on "Justice, Common Sense, and the Pay Roll," delivered at the N. Y. meeting of the Nat. Civic Fed., Jan. 12, 1911. Discusses the element of justice in scientific management. 3500 w. Ir Age—Jan. 19, 1911. No. 20278.

See also same title, under RAILWAY ENGINEERING, MISCELLANY.

Monopoly.

Monopoly and Progress. Dr. Franz Junge-Hermsdorf. Second of three articles on industrial conditions in the United States. The present number discusses the menace of international money power. 4500 w. Engineering Magazine—Feb., 1911. No. 20678 B.

Patents.

Patents—What They Are, and How to Read and Understand Them. S. E. Darby. An elementary explanation of the nature of patents. 2500 w. Elec Ry Jour—Jan. 21, 1911. No. 20294.

Southern States.

Some Fundamental Elements in Southern Industrial Development. Dr. David T. Day. Reviews the industries that have contributed to the rapid development of the South. 3000 w. Mfrs' Rec—Jan. 5, 1911. No. 19992.

Stores Keeping.

See Supply Department, under RAILWAY ENGINEERING, MOTIVE POWER AND EQUIPMENT.

Wage Systems.

The Premium Plan of Paying for Labor. Clinton Alvord. An explanation of the premium plan and its working, comparing with other systems. 4000 w. Jour Worcester Poly Inst—Jan., 1911. No. 20319 C.

MARINE AND NAVAL ENGINEERING

Battleships.

Progress of Warships and Machinery Under Construction in England. Review of progress in naval construction in England during the last six months of 1910. 2500 w. Engr, Lond—Jan. 13, 1911. No. 20518 A.

The Armament of Recent Battleships (Les Installations d'Artillerie à Bord des Cuirassés récents). P. Bourgoin. Discusses the arrangement of guns and mechanisms for their operation. Ills. 10500 w. Rev Gen d Sci—Dec. 30, 1910. No. 20417 D.

Colliers.

Fleet Collier Cyclops. Illustrates and describes the leading characteristics of this vessel, of the twin screw, single deck type. 1500 w. Marine Rev—Jan., 1911. No. 20239.

Dredges.

Clay-Cutting Hydraulic Dredger for the River Nile. Illustrated description. 700 w. Engng—Jan. 6, 1911. No. 20263 A.

Two New Dredgers. Illustrations and brief descriptions of a twin-screw suction and buckel-dredger for the Hai-Ho River, and a bow-well bucket dredger for Adelaide harbor. 500 w. Engr, Lond—Dec. 30, 1910. No. 20097 A.

German and American Electrically Operated Bucket Dredges (Elektrisch angetriebene Löffelbagger deutscher und amerikanischer Bauart). Hubert Hermanns. Describes a number of types. Ills. 4000 w. Elek Kraft u Bahnen—Dec. 24, 1910. No. 20494 D.

Electric Power.

Ship Propulsion by Electricity (Indirekte elektrische Schiffsantriebe). F.

Niethammer and E. Siegel. An illustrated review of the various direct- and alternating-current systems proposed. Ils. 3700 w. Elek Kraft u Bahnen—Dec. 4, 1910. No. 20492 D.

Ferryboats.

Screw Ferryboat Dutchess. Illustrated description of this steel ferry steamer. 700 w. Int Marine Engng—Jan., 1911. No. 19925 C.

Paddle Ferry Steamer San Pedro. Profile, plans, and description of a new ferryboat for the A., T. & S. F. R. R. Co., building at San Francisco. It is of the double ended paddle type with feathering wheels. 1000 w. Marine Rev—Jan., 1911. No. 20237.

Gas Engines.

Producer Gas for Marine Service. E. W. Graef. Describes small plants, ranging from 25 to 200-h.p. which are easily handled by one man. 2200 w. Rudder—Jan., 1911. No. 20109 C.

German Association.

The Twelfth Session of the German Naval Association (Die Zwölfte Hauptversammlung der Schiffbautechnischen Gesellschaft). O. Flamm. Abstracts of the papers and discussions. Ills. Serial. 1st part. 4800 w. Schiffbau—Dec. 14, 1910. No. 20458 D.

Hydroplanes.

How to Build a Glider, Kestrel. Walter M. Billing. An illustrated study of the construction of gliders, and of materials used. 3000 w. Rudder—Jan., 1911. No. 20108 C.

Naval Engineering.

Naval Engineering Progress. H. I. Cone. Abstract of a lecture at the Newport Naval War College. Reviews improvements introduced and the results. 7000 w. Int Marine Engng—Jan., 1911. No. 19926 C.

Naval Organization.

Engineering in the Navy. Its Organization and Efficiency. Ira N. Hollis. An endorsement of Sec. Meyers reorganization of the Navy. 7000 w. Engineering Magazine—Feb., 1911. No. 20677 B.

Oil Engines.

An Ocean-Going Oil Engine Ship. Illustrated description of the "Vulcanus," a full-powered ocean-going internal-combustion-engine boat. Fitted with a reversible Diesel motor. 4000 w. Engr, Lond—Jan. 6, 1911. Serial. 1st part. No. 20270 A.

Propulsion.

Modern Methods of Marine Propulsion (Moderni Mezzi di Propulsione Marina). E. Ferretti. A review of recent proposals, involving the use of gas, oil, or electric power, speed-reducing gears, etc. Ills. 16000 w. Riv Marit—Dec., 1910. No. 20437 E + F.

The Application of the Jet Propeller in Turbine Steamers (Ueber die Verwendbarkeit des Pumpenpropellers bei Turbinendampfern). Moritz Kroll. Examines the possibility of employing centrifugal pumps driven by turbines for ship propulsion. Ills. 3000 w. Zeitschr f d Gesamte Turbinenwesen—Dec. 10, 1910. No. 20467 D.

Review of 1910.

See Shipbuilding, under MARINE AND NAVAL ENGINEERING.

Salving.

The Army Engineers' Plan for Raising the Wreck of the "Maine": The Design of Cofferdams for Very Deep Water. Editorial on the object of the work and the means of carrying it out, especially considering the cofferdams. Ills. 3000 w. Eng News—Dec. 29, 1910. No. 19799.

Salving the Northwestern. An account of this Alaska liner, stranded in Puget Sound, describing methods used to successfully bring the vessel into Seattle harbor for repairs. 1200 w. Marine Rev—Jan., 1911. No. 20238.

The Rescue of a Sunken German Submarine. Illustrated account of how the "U. 3" was raised by a special floating dock built for that purpose. 800 w. Sci Am—Jan. 28, 1911. No. 20642.

Shipbuilding.

Shipbuilding and Marine Engineering in 1910. A review of this industry in the United Kingdom. 9000 w. Engng—Jan. 6, 1911. No. 20268 A.

Naval Shipbuilding in 1910. Editorial review of the progress during the past year in the navy shipbuilding of Great Britain. 3000 w. Engng—Dec. 30, 1910. No. 20093 A.

Chantier et Ateliers de St. Nazaire. Illustrates and describes work at the Penhoët shipbuilding yard, on the Bay of Biscay, and the equipment of the yard. Plate. 5000 w. Engng—Dec. 23, 1910. No. 19972 A.

Shipbuilding Rules.

Germanischer Lloyd Rules, 1910. Arthur R. Liddell. Reviews the changes made and new ideas embodied in the 1910 edition of the rules of this society. 2000 w. Engr, Lond—Dec. 30, 1910. No. 20099 A.

Ship Resistance.

Water Resistance of Birds and Bird Forms. Tatsugoro Inouye. Written from the "graduation essay." Investigations showing advantage of bird-form over ship-form. Ills. 800 w. Engng—Jan. 13, 1911. No. 20517 A.

Ship Stability.

Graphical Representation of the Stability and Trim of Ships (Graphische Darstellung der Anfangsstabilität und Trimlagen von Schiffen). E. Veronese. Outlines a method of investigation. Ills. 1200 w. Schiffbau—Dec. 14, 1910. No. 20459 D.

Ship Testing.

The Determination of the Height of the Centre of Gravity by Means of Listing Tests (Bemerkungen über die Bestimmung des Gewichtsschwerpunktes der Höhe nach mit Hilfe des Krängungsversuches). Alfred Schmidt. Describes the method. Ills. 1800 w. Schiffbau—Dec. 28, 1910. No. 20460 D.

Steam Boilers.

The Design of a Marine Boiler. An illustrated study of the design of a four-furnace boiler. 4500 w. Boiler Maker—Jan., 1911. No. 20111.

An Improved Type of Marine Boiler. C. M. Olsen. The improvement consists in dispensing with the water-filled space around the combustion chamber, and arranging a water tube system and superheater in the space gained. Ills. 1000 w. Boiler Maker—Jan., 1911. No. 20112.

Steamships.

A Tank Steamer for the Molasses Trade. Illustrated detailed description of the steamer "Currier," to run between Cuba, Porto Rico, and New York. 3500 w. Int Marine Engng—Jan., 1911. No. 19927 C.

United States Navy.

See Naval Organization, under MARINE AND NAVAL ENGINEERING.

Yachts.

British-Built Power Yachts. J. Rendell Wilson. Illustrates and describes interesting points in connection with the machinery of recent power yachts built in English yards. 2000 w. Rudder—Jan., 1911. No. 20107 C.

MECHANICAL ENGINEERING

AERONAUTICS.

Aeroplane Design.

Disposition of Motors and Seats in Aeroplanes (Disposition des Motors und der Sitze bei Flugapparaten). Hans Zeyssig. Reviews the principles and gives examples of practice. Ills. Serial. 1st part. 1200 w. Motorwagen—Dec. 30, 1910. No. 20473 D.

Aeroplanes.

Two Interesting New French Aeroplanes. Illustrated descriptions of the De Pishof monoplane, and the Paulhan biplane. 1500 w. Sci Am—Jan. 28, 1911. No. 20641.

Aeroplane Speed.

A Study of the Variable-Speed Aeroplane (Etude d'un Aéroplane à Vitesse variable). Suggests lines of inquiry which may lead to increased safety in aeroplanes. Ills. 2700 w. Génie Civil—Dec. 24, 1910. No. 20433 D.

Aeroplane Stability.

Automatic Stabilizing System of the Wright Brothers. Illustrated description of an interesting control system for the Wright aeroplanes. 1800 w. Sci Am Sup—Jan. 14, 1911. No. 20173.

Airship Flights.

The Brucker Transatlantic Airship Expedition. Carl Dienstbach. Illustration and account of the airship, under construction, which will attempt to cross the Atlantic from the Cape Verde Islands, traveling with the trade winds. 2500 w. Sci Am—Jan. 21, 1911. No. 20387.

Exhibitions.

The Paris Aeronautical Exhibtion. W. F. Bradley. Illustrates and describes the exhibits as types of the most recent aeroplanes and motors. 2500 w. Cassier's Mag—Jan., 1911. No. 20301 B.

Motors.

Aeroplanes and Airship Engines. Illustrates and describes a number of designs. 2500 w. Mach, N Y—Jan., 1911. No. 19880 C.

French Aeroplane Engines. Warren H. Miller. Brief illustrated descriptions of famous French engines for aeroplanes. 2500 w. Rudder—Jan., 1911. No. 20110 C.

The N. E. C. Two-Stroke Petrol Engine. Illustrated description of a new engine used on a Wright biplane. 1500 w. Auto Jour—Dec. 24, 1910. No. 19955 A.

Review of 1910.

Progress in Aviation in 1910. Rene Gasnier. in *L'Aerophile*. A review. 2500 w. Sci Am Sup—Jan. 7, 1911. No. 19944.

Aeronautics. Reviews the notable flights of 1910, and comments on the elimination of chance, and the showman's influence. 3500 w. Engr, Lond—Jan. 6, 1911. No. 20272 A.

AUTOMOBILES.

Agricultural Machinery.

Agricultural Motor Trials. Gives details of the trials held by the Roy. Agri. Soc. of England at Boldock. 4000 w. Engng—Jan. 13, 1911. No. 20512 A.

Ball Bearings.

Loads on Rear-Axle Ball Bearings (Belastung von Kugellagern in Automobillinterradachsen). J. Dornacher. Tabulates the loads on bearings in various European cars. Ills. Serial. 1st part. 2000 w. Motorwagen—Dec. 20, 1910. No. 20472 D.

Brakes.

Something New in Brakes. Illustrates and describes the Giusti pneumatic brake system. 1500 w. Auto Jour—Dec. 31, 1910. No. 20075 A.

Carburetors.

Carburetors and Fuel Systems at the Show. Albert L. Clough. General review of features of interest. 2500 w. Horseless Age—Jan. 18, 1911. No. 2038

Unique System of Carburation. Illustrates and describes the Welsh automatic carburettor. 2000 w. Auto Jour—Dec. 31, 1910. No. 20074 A.

Commercial Vehicles.

The Commercial Motor Truck vs. the Horse. Harry W. Perry. An illustrated comparison of efficiency and cost. 3000 w. Sci Am—Jan. 14, 1911. No. 20170.

Accessibility of Parts in Commercial Vehicles. H. A. Morris. Discusses the importance of this feature of design. 4000 w. Com Veh—Jan., 1911. No. 20015 C.

Worm Drive Latest for Commercials. Illustrated review of features observed at the recent show in Madison Square Garden, N. Y. 3000 w. Automobile—Jan. 26, 1911. No. 20687 C.

Gasoline Motor Trucks and Delivery Wagons at the Palace Show. A. C. Woodbury. General review of the exhibits. 1800 w. Horseless Age—Jan. 11, 1911. No. 20206.

Mechanical Review of the Commercial Vehicle Show. A. C. Woodbury. Illustrates and describes interesting features of the exhibits. 4000 w. Horseless Age —Jan. 25, 1911. No. 20655.

See also Garages, under AUTOMOBILES.

Cost.

Why You Can Buy a Good Car for Little Money. Harold Whitney Slauson. Shows how the mass production of motor cars has made possible efficient automobiles at lower prices. 3000 w. Sci Am—Jan. 14, 1911. No. 20169.

Cunningham.

Cunningham Car. Illustrated description of a new car shown at the Palace Auto Show, N. Y. 1500 w. Horseless Age—Jan. 11, 1911. No. 20205.

Design.

The Structural Engineering of Motor-Cars. John L. Milligan. Read before the Manchester Assn. of Engrs. Deals only with pleasure cars. Ills. 2500 w. Mech Wld—Dec. 23, 1910. Serial. 1st part. No. 19965 A.

Electric.

The Modern Pleasure Electric Vehicle. William W. Hudson. Illustrated detailed description of interesting improvements in design and construction. 2200 w. Sci Am—Jan. 14, 1911. No. 20167.

See also Garages, under AUTOMOBILES.

Electric Meters.

Ampere-Hour Meter for Electrics. R. C. Lanphier. Read before the Soc. of Auto. Engrs. Types of ampere-hour meters are illustrated and described, explaining the principle and value. 4000 w. Automobile—Jan. 19, 1911. No. 20356.

Exhibitions.

Eleventh A. L. A. M. Show Greatest Ever Seen. Illustrated general description of arrangements at Madison Square Garden, N. Y. City. 3500 w. Horseless Age—Jan. 11, 1911. No. 20201.

Mechanical Features of Cars at the Palace Show. A. C. Woodbury. Reviews features of construction embodied in the cars shown, which are mostly of the low or medium priced class. 3500 w. Horseless Age—Jan. 4, 1911. No. 20062.

Some New Mechanical Features at the Palace Show. Chester S. Ricker. Illustrates and describes the Cole lubrication system, oil circulation bv flywheel, valve covers instead of valve caps, etc. 2000 w. Horseless Age—Jan. 11, 1911. No. 20204.

Enclosed Front Bodies at the Palace Show. Chester S. Ricker. Illustrates and describes features of interest at this exhibition in New York City. 5000 w. Horseless Age—Jan. 4, 1911. No. 20061.

Control Systems at the Madison Square Show. D. R. Hobart. Remarks on the diversity of design of the various levers and pedals. Ills. 2500 w. Horseless Age —Jan. 11, 1911. No. 20203.

Body Details at Garden Show. Chester S. Ricker. Exhibits are illustrated and described. 2500 w. Horseless Age—Jan. 11, 1911. No. 20202.

The Automobile at the Brussels Exposition (Das Automobil auf der Brüsseler Weltausstellung 1910). A. Haenig. A review of the exhibits. Ills. Serial. 1st part. 3600 w. Zeitschr d Mit Motorwagen Ver—Dec. 31, 1910. No. 20471 D.

Wheels and Tires at the Paris Salon, Dec. 3-18, 1910 (Les Roues et les Bandages au Salon de l'Automobile, Paris, 3-18 Décembre 1910). Jean Boutaric. Describes the novelties among the exhibits. Ills. 2000 w. Génie Civil—Dec. 17, 1910. No. 20430 D.

Fire Apparatus.

Apparatus for Efficient Fire Fighting. Arguments favoring the adoption of motor fire apparatus. 1700 w. Munic Engng —Jan., 1911. No. 20333 C.

Fires.

Fire Protection. N. B. Pope. Read before the Soc. of Auto Engrs. Brief discussion of the causes and methods of prevention. 1200 w. Automobile—Jan. 12, 1911. No. 20193 C.

Garages.

The Small, Inexpensive Garage. H. P. Wilkin. Illustrates and describes knockdown and unit type of portable structures. 3000 w. Sci Am—Jan. 14, 1911. No. 20172.

Proper Garaging of Electric Commercial Vehicles. C. L. Morgan. From a paper read before the Elec. Veh. Assn. of Am. The best equipment for garages and methods to be adopted for the care and maintenance of machines. 3000 w. Com Veh—Jan., 1911. No. 20016 C.

Gears.

Efficiency of Worm Drives. F. E. Watts. Gives data of tests showing that it is possible to secure efficiencies approximating 90 per cent. 1500 w. Horseless Age—Dec. 28, 1910. No. 19849.

Ignition.

Magneto Ignition Practices. Discusses and illustrates magnetos employed in automobile ignition work, stating the limitations. 4500 w. Automobile—Jan. 12, 1911. No. 20195 C.

Lighting.

Electric Lighting Systems. A review of general principles with details of the most widely used types. Ills. 2500 w. Serial. 1st part. Autocar—Jan. 14, 1911. No. 20394 A.

Electric Lighting Systems Seen at the Show. Albert L. Clough. Describes several of the systems shown, calling attention to the differences. 1600 w. Horseless Age—Jan. 18, 1911. No. 20385.

Motor Compression.

Variation of Mean Effective Pressures in Automobile Engines. David Landau. An investigation of the effects of compression, compression chamber form, piston speed, valve sizes and valve timing. 2500 w. Horseless Age—Jan. 25, 1911. Serial. 1st part. No. 20657.

Motor Design.

Power Calculations for Motors. W. D. Ennis. Suggests a method for determining the (water-cooled) cylinder dimensions suitable for required service regardless of horse-power rating. 2500 w. Automobile—Jan. 5, 1911. No. 20054 C.

Motor Efficiency.

Carbon Monoxide Stifles Efficiency. Calls attention to the loss of power and lack of fuel economy due to thermic troubles. 3000 w. Automobile—Jan. 5, 1911. No. 20055 C.

Thermal Efficiency of a Two-Cycle Petrol Engine. W. Watson and R. W. Fenning. Read before the Incor. Inst. of Auto. Engrs. Describes a series of experiments carried out, stating results. Ills. 2500 w. Auto Jour—Dec. 24, 1910. Serial. 1st part. No. 19956 A.

Motor Fuels.

Commercial Gasoline. F. H. Floyd. Read before the Soc. of Auto. Engrs. Discusses the impurities that are being encountered. 4000 w. Automobile—Jan. 12, 1911. No. 20189 C.

Motor Lubrication.

Lubrication for Motors. Shows how the pressure varies and discusses the efficacy of the plans in vogue. 2000 w. Automobile—Jan. 5, 1911. No. 20056 C.

Motors.

Technical Review of Motors. Review of development, discussing types and features of design. 10000 w. Automobile—Jan. 26, 1911. No. 20685 C.

Two Cycle Engines at the Madison Square Garden Show. A. C. Woodbury. Describes changes and new designs shown. Ills. 2000 w. Horseless Age—Jan. 25, 1911. No. 20656.

The Two-Stroke Engine. Some facts relating to the faults of the old type and to recent improvements. 2200 w. Auto Jour—Dec. 24, 1910. No. 19954 A.

New Sleeve Type of Motor. Information concerning a patent issued to Robert Miller, relating to 4-cycle internal combustion motors of the sleeve type. Ills. 1800 w. Automobile—Dec. 29, 1910. No. 19854.

Motor Valves.

Novelties in Valves. E. P. Batzell. Read before the Soc. of Auto. Engrs. Outlines recent developments, including combinations of rotary, poppet, sleeve, piston and others. Ills. 3500 w. Automobile—Jan. 12, 1911. No. 20191 C.

Slide-Valve Motors (Schiebermotoren). K. Praetorius. A discussion of the valve problem in automobile motors. Ills. Serial. 1st part. 1000 w. Motorwagen—Dec. 30, 1910. No. 20474 D.

Omnibuses.

Motor-Omnibuses of the Paris General Omnibus Company. Illustrates and describes improvements introduced in the latest vehicles for this company. 1200 w. Engng—Jan. 13, 1911. No. 20514 A.

Repairs.

A Few Shop Jobs on an Old Car. Herbert L. Towle. Useful hints for the man handy with tools. 2000 w. Sci Am—Jan. 14, 1911. No. 20171.

Road Guides.

Some Remarkable Mechanical Road Guides. Harry W. Perry. Illustrates and describes ingenious devices for indicating the proper route for touring cars. 2000 w. Sci Am—Jan. 14, 1911. No. 20168.

Selden Patent.

The Defect of the Selden Patent. Editorial on the decision of the U. S. Court of Appeals, reversing the decision of the Circuit Court which in 1909 affirmed the validity of the Selden automobile patent. 2500 w. Eng News—Jan. 19, 1911. No. 20288.

Sleighs.

Motor Sleighs for Antarctic Expeditions. Drawings and details of the sleigh and motor, with description. 1000 w. Engng—Dec. 23, 1910. No. 19973 A.

Testing.

Mechanical Proving of Automobiles. John Squires. Describes tests made with an absorption dynamometer. Ills. 3000 w. Am Mach—Jan. 26, 1911. No. 20604.

Tires.

Semi-Pneumatic Tyre Construction. Illustrated description of the "E. D." tyre. 1800 w. Auto Jour—Jan. 14, 1911. No. 20395 A.

Care and Repair of Tires. Suggestions for the care of the spare tire so that it will not deteriorate. Ills. 1500 w. Automobile—Dec. 29, 1910. No. 19852.

Transmission.

Transmission. Discusses prevailing types of automobile transmission gears, flexibility, etc. Ills. 2200 w. Automobile—Jan. 26, 1911. No. 20686 C.

Relation of the Gear Ratio. William D. Ennis. Discussing the ability of the motor, the work it has to do, the governing condition, etc. 2000 w. Automobile—Jan. 26, 1911. No. 20688 C.

"Frictionless" Friction Drive. Charles E. Duryea. Read before the Soc. of Auto. Engrs. Treats of roller, shaft, and chain types of drives in motor operation, giving results of tests. 3000 w. Automobile—Jan. 12, 1911. No. 20190 C.

See also Commercial Vehicles and Gears, under AUTOMOBILES.

Wheels.

Demountable Rims. Illustrates and describes various schemes used to facilitate the replacement of tires. 2000 w. Automobile—Jan. 12, 1911. No. 20196 C.

Spoke Material Running Short. Discusses methods by which the supply of hickory can be maintained. 3000 w. Automobile—Jan. 19, 1911. No. 20354.

Avoid Broken Wheels. Gives characteristics and tests of hickory as it is used for spokes and felloes for automobile wheels, showing how to avoid defective wood. 1500 w. Automobile—Dec. 29, 1910. No. 19853.

COMBUSTION MOTORS.

Gas-Engine Design.

See Engine Design, under STEAM ENGINEERING.

Gas Engines.

Compression and Explosion Pressures and Temperatures in Gas and Oil Engines. W. Manktelow. Mathematical discussion of compression pressures and temperatures. 1200 w. Mech Wld—Jan. 6, 1911. Serial. 1st part. No. 20256 A.

A New German Gas Engine. Illustrates and describes details of the double-acting, four-cycle engine built by Ehrhardt & Sehmer. 1800 w. Ir Age—Jan. 5, 1911. No. 19911 D.

Gasoline Engines.

See Motor Efficiency, under AUTOMOBILES.

Gas-Power Plants.

Gas and Oil Engine Central Stations (Stations centrales à Gaz pauvre et à Moteurs Diesel, à Huile lourde). P. Calfas. An abstract of the report of M. Thonet to the International Tramway Congress last September, giving data of first and operating costs in a number of large stations. Ills. 3500 w. Génie Civil—Dec. 24, 1910. No. 20432 D.

See also Refrigeration, under HEATING AND COOLING.

Gas Producers.

Recent Gas Producers (Quelques Gazogènes récents). A review of recent gas-producer literature and patents. Ills. 7500 w. Rev de Mécan—Dec., 1910. No. 20413 E + F.

Oil Engines.

See Gas Engines, under COMBUSTION MOTORS; and Oil Engines, under MARINE AND NAVAL ENGINEERING.

HEATING AND COOLING.

Hot-Air Heating.

A New England School Heating System. Plans and description of a system installed in Braintree, Mass. 2000 w. Met Work—Jan. 7, 1911. No. 19989.

Design of Fan Blast Heating. H. C. Russell. Gives data on the proportioning of heating apparatus for factories, schools and public buildings. 2000 w. Met Work—Jan. 21, 1911. Serial. 1st part. No. 20348.

Hot-Water Heating.

See Steam Heating, under HEATING AND COOLING.

Liquid Oxygen.

Separation of Oxygen by Cold. James Swinburne. A Faraday Soc. paper. Explains the principle and its application. 6000 w. Met & Chem Engng—Jan., 1911. No. 20128 C.

Modern Practice.

What Is the Matter with Modern Heating Practice? Konrad Meier. An answer to the agitation against present methods. 3500 w. Heat & Vent Mag—Jan., 1911. No. 20568.

Plumbing.

Plumbing in a New York Apartment House. Illustrates and describes numerous special features. 3000 w. Met Work—Jan. 7, 1911. No. 19987.

Refrigeration.

Clearance and Its Effect on the Volumetric Efficiency of Ammonia Compressers. V. R. H. Greene. Read before the Am. Soc. of Refrig. Engrs. Presents results of research work. 2500 w. Ice & Refrig—Jan., 1911. No. 19999 C.

Clearance in Single-Acting and Double-Acting Ammonia Compressors. Thomas Shipley. Read before the Am. Soc. of Refrig. Engrs. Gives data from test runs. Ills. 500 w. Ice & Refrig—Jan., 1911. No. 20000 C.

A description of the "Mederer" Chilling Chamber. H. W. Miller. Illustrated description of a chamber for producing artificial cold for the preservation of food stuffs. Discussion. 2500 w. Jour S African Assn of Engrs—Oct.-Nov., 1910. No. 20073 F.

A Gas Producer Operated Refrigerating Plant. Roderick H. Tait. Read before the Am. Soc. of Refrig. Engrs. Plan and description of a gas-driven plant. 2000 w. Ice & Refrig—Jan., 1911. No. 19998 C.

Steam Heating.

Pipe Line Sizes for Central Station Heating. Byron T. Gifford. Read before the Am. Soc. of Heat. & Vent. Engrs. Explains a simple manner of determining the proporting for both steam and hot-water systems. 1500 w. Met Work—Jan. 28, 1911. No. 20632.

Rehabilitation by Vacuum Heating. Illustrated description of changes in the Boston City Hospital to secure better performance of heating plants. 3500 w. Met Work—Jan. 21, 1911. No. 20347.

Temperature Control.

Temperature Control in House Heating. Illustrates and describes types of apparatus for securing satisfactory and economical control of heating equipment. 2000 w. Met Work — Jan. 7, 1911. No. 19990.

Ventilation.

The Transmission of Air and Its Movement in Ducts. George W. Knight and Perry West. The development of a new scheme for proportioning air ducts and outlets. 3000 w. Heat & Vent Mag—Jan., 1911. No. 20567.

Mechanical Ventilation. J. Radcliffe. Based on a paper read before the Heat. & Vent. Engrs. Discusses the requirements of a perfect system of ventilation and means of attaining the desired results. 3000 w. Mech Engr—Jan. 6, 1911. No. 20252 A.

Notable Scheme of School Ventilation. Illustrates and describes the system installed in the East Side High School, Pittsburg. Has an air tunnel 15 ft. wide and 6 ft. high, and exhaust air tunnels underneath fresh air tunnels. 5000 w. Met Work—Jan. 7, 1911. No. 19986.

The Ventilation of Large Halls (Lüftung und Kühlung von Sälen). M. Hottinger. A practical discussion of the desiderata and methods of securing them. Ills. Serial. 1st part. 2500 w. Schweiz Bau—Dec. 10, 1910. No. 20464 D.

HYDRAULIC MACHINERY.

Centrifugal Pumps.

The Influence of Form of Blades in Centrifugal Pumps. Maurice F. Fitzgerald. An analytical and graphical study. Ills. 2000 w. Engr, Lond—Dec. 30, 1910. No. 20094 A.

The "Tan-Gyro" Centrifugal Pump. Illustrated description of a high-efficiency rotary pump. 1000 w. Engng—Jan. 6, 1911. No. 20265 A.

Recent Centrifugal Pumps (Neuere Zentrifugalpumpen). G. Ziehn. Describes new theories, new types, and new applications. Ills. Serial. 1st part. 4000 w. Die Turbine—Dec. 20, 1910. No. 20466 D.

Standardization of Centrifugal Pumps by the Firm of A. Borsig (Die Normalisierung der Kreiselpumpen bei A. Borsig in Berlin-Tegel). Ernst Blau. Describes the sizes and types manufactured for stock by this firm. Ills. 2300 w. Zeitschr d Ver Deutscher Ing—Dec. 31, 1910. No. 20708 D.

Gas Pumps.

Humphrey Internal Combustion Pump. Edward N. Trump. The Humphrey gas pump is illustrated and described, and tests reported. 4000 w. Am Mach—Jan. 5, 1911. No. 20229.

Presses.

See Hydraulic Presses, under MACHINE ELEMENTS AND DESIGN.

Turbines.

Reaction Turbines to Operate Under 670 Feet Head. H. Birchard Taylor. Illustrates and describes the design of the turbines being erected in the Noriego plant of the Michoacan Power Co., in Mexico. 3500 w. Eng Rec—Jan. 21, 1911. No. 20338.

MACHINE ELEMENTS AND DESIGN.

Ball Bearings.

Recent Tests of Ball and Roller Bearings (Nouveaux Essais sur les Roulements à Billes et à Rouleaux). Ch. Gégauff. An extension of the author's previous tests investigating the comparative amounts of power absorbed by ball, roller, and ordinary bearings under various conditions. Ills. 4200 w. Génie Civil—Dec. 3, 1910. No. 20425 D.

Recent Ball and Roller Bearings and Their Trial in Practice (Neuere Kugel- und Rollenlager und deren Bewährung in der Praxis). August Bauschlicher. Describes various types recently developed in Germany. Ills. Serial. 1st part. 2500 w. Zeitschr f Werkzeug—Dec. 5, 1910. No. 20476 D.

See also Lubrication, under POWER AND TRANSMISSION.

Bushes.

The Fitting of Bushes. James Stormonth. Suggestions, with illustrations. 2000 w. Mech Wld—Dec. 30, 1910. No. 20087 A.

Standard Bushings for Drill Jigs. Lucian Haas. Illustrations and dimensions of standard types which experience has proved satisfactory. 1100 w. Am Mach—Vol. 33. No. 51. No. 20219.

Clutches.

The Design of Leather Cone Clutches. Considers the principles underlying the proportions of the frictional surfaces. 1800 w. Autocar—Dec. 31, 1910. No. 20076 A.

Friction Clutch for Machine Tools. Robert Reid. A pneumatically operated friction clutch, successfully applied to large planers and slotters, is illustrated and described. 1600 w. Am Mach—Jan. 12, 1911. No. 20234.

Elastic Bodies.

Propagation of Stresses in Elastic Bodies (Propagation des Pressions dans les Corps elastiques). R. A. Henry. A theoretical and experimental investigation. Ills. 7000 w. Rev de Métal—Dec., 1910. No. 20409 E + F.

Hydraulic Presses.

Strain Rods for Hydraulic Presses. A. Lewis Jenkins. Gives formulae for determining the proportions of the tension members, with illustrations of different methods of fastening. 1000 w. Am Mach—Vol. 33. No. 52. No. 20224.

Rotating Drums.

The Design of Rotating Drums (Die Berechnung rotierender Trommeln). A criticism of R. Lorenz's paper on this subject by Kurt von Sanden, with a reply by Dr. Lorenz. Ills. 4200 w. Zeitschr d Ver Deutscher Ing—Dec. 3, 1910. No. 20704 D.

Screw Threads.

The Unification of Systems of Screw Threads (L'Unification des Systèmes de Filetage). F. Cellerier. Outlines the present state of the movement for international standardization. Ills. 6000 w. Tech Mod—Dec., 1910. No. 20414 D.

Springs.

Finding the Value of "E" for Springs. George F. Summers. Gives a simple test by which the quality of the material may be determined. Ills. 600 w. Am Mach—Jan. 26, 1911. No. 20602.

MACHINE WORKS AND FOUNDRIES.

Aluminum Founding.

Oxidation of Aluminum. Considers aluminum castings and methods of preventing porosity. 2000 w. Foundry—Jan., 1911. No. 19907.

Annealing.

See Malleable Iron, under MATERIALS OF CONSTRUCTION.

Assembling.

The Assembly of Small Interchangeable Parts. John Calder. Outlines a system for securing rapid and economical production. 2200 w. Jour Am Soc of Mech Engrs—Jan., 1911. No. 20573 F.

Brass Founding.

American Practice in Casting Brass for Rolling; A Description of the Methods Now Used in the Casting Shops of the Leading Brass Rolling Mills. Erwin S. Sperry. Ills. 4000 w. Brass Wld—Jan., 1911. No. 20298.

Blemishes on Brass Castings. C. Vickers. Discusses methods necessary to produce fine brass work. Ills. 3000 w. Foundry—Jan., 1911. No. 19906.

Button Making.

Punches and Dies for Metal Buttons. A. F. Horton. Illustrated description of combination dies for blanking, drawing and embossing at one operation. 1500 w. Am Mach—Jan. 26, 1911. No. 20605.

Cam Cutting.

Cutting Plate Cams on Milling Machine. R. F. Biesemeier. Has particular reference to the making of plate cams for the automatic screw machine. Gives tables of gearing and angles of inclination for leads between 0.075 and 5 inches. Ills. 2500 w. Am Mach—Jan. 12, 1911. No. 20232.

Milling Screw Machine Cams. William W. Johnson. Illustrates and describes a method of finding the angle to which the spiral head is to be set, and the lead for which the spiral head is to be geared. Supplement. 1500 w. Mach, N. Y—Jan., 1911. No. 19879 C.

Castings.

Die-Casting. A. C. von Dreele. Illustrates and describes the process, machinery and dies used in an interesting manufacturing operation. 4000 w. Mach, N. Y—Jan., 1911. Serial. 1st part. No. 19877 C.

Chip Briquettes.

Briquettes from Cast Borings. Reviews two recent articles in *Stahl und Eisen*, by E. Leber, and A. Messerschmidt, on results from their use in making iron castings, with special reference to cupola reactions. 2500 w. Ir Age—Jan. 12, 1911. No. 20113.

Briquetting Cast-Iron Chips and Their Utilization in the Cupola (Die Brikettierung von Guss- und Eisenspänen und ihre Schmelzung im Kupolofen). A Messerschmidt. Reviews unsatisfactory results of using cast-iron chips in the cupola without briquetting, and discusses the behavior in the cupola of briquettes made by the Ronay process. Ills. 8750 w. Stahl u Eisen—Dec. 7. 1910. No. 20444 D.

Chips.

Melting Cast Iron Chips in the Cupola. W. F. Prince. Gives full details of the Prince process which has given successful results. Ills. 2500 w. Am Mach—Jan. 26, 1911. No. 20601.

Cupola Practice.

Utilization of Cast Iron Borings. John Jacobson. Gives excellent results obtained from the Prince process of charging borings in the cupola. Ills. 2000 w. Foundry—Jan., 1911. No. 19905.

See also Chips, and Chip Briquettes, under MACHINE WORKS AND FOUNDRIES.

Cutting Metals.

The Heat Generated in the Process of Cutting Metal. H. I. Brackenbury and G. M. Meyer. Investigates the rise of temperature quantitatively of chips when the cutting speed is increased, and considers the temperature of the work from which the chips have been removed. 2000 w. Engng—Jan. 13, 1911. No. 20510 A.

Cutting Tools.

External Cutting Tools. Douglas T. Hamilton. Illustrated detailed description of the construction and use of each tool, the various parts, functions and applications. The practice for the Brown & Sharpe automatic screw machine. 2500 w. Mach, N. Y—Jan., 1911. Serial. 1st part. No. 19878 C.

Heat Treatment of High-Speed Tools. C. P. Berg. A discussion of the relation between temperature and life of tools. Ills. Also discussion. 7500 w. Jour W Soc of Engrs—Dec., 1910. No. 20554 D.

Dies.

Metals Inserted into Die Castings. H. C. Skinner. Illustrates and describes methods employed to give greater strength to certain parts. 1000 w. Am Mach—Jan. 19, 1911. No. 20368.

Making Dies for Drop Forgings. S. G Hollander. Suggestions of service in die sinking. Ills. 3000 w. Am Mach—Jan. 19, 1911. No. 20367.

Forging.

See Shop Design, under MACHINE WORKS AND FOUNDRIES.

Foundries.

The Columbia Steel Foundry Illustrates and describes details of a recently opened Pacific Coast open-hearth steel castings plant. 1200 w. Ir Age—Jan. 12, 1911. No. 20114.

Job Shop for Light Steel Castings. Illustrated description of the plant of the West Steel Casting Co. at Cleveland, O., which specializes in the production of converter and crucible steel castings. 2500 w. Foundry—Jan., 1911. No. 19903.

Continuous Cast Iron Pipe Foundry. Illustrates and describes a straight floor system for the continuous production of water pipe, the cycle of operations and method of making cores. 6000 w. Foundry—Jan., 1911. No. 19902.

Foundry Appliances.

Scientifically Designed Gaggers and Their Use. Reports experiments made with old and new forms of foundry gaggers. Ills. 2000 w. Castings—Jan., 1911. No. 20281.

Foundry Design.

A Proposed Malleable Castings Plant. Gives the layout, construction and arrangement of equipment in a customs foundry. 2000 w. Ir Age—Jan. 5, 1911. No. 19921 D.

Foundry Furnaces.

Combustion in Foundry Furnaces (Die Verbrennung beim Betriebe von Giessereiflammöfen). Erich Rosenberg. A discussion of fuel consumption and economy in coal-fired furnaces. Ills. 2700 w. Stahl u Eisen—Dec. 7, 1910. No. 20445 D.

Foundry Practice.

The Progress of Mechanical Engineering in the Foundry. George K. Hooper. Illustrated review of recent improvements, with special reference to the "continuous pouring" or "mechanical handling" system. 2200 w. Ir Age—Jan. 5, 1911. No. 19923 D.

Metallurgy in the Foundry. Discusses the working up of scrap, and the mixing of irons for different sources. 2000 w. Prac Engr—Jan. 13, 1911. No. 20505 A.

Recent Tendencies in the Foundry Industry. Dr. R. Moldenke. Remarks on the increasing use of machinery, especially in molding. 2000 w. Ir Age—Jan. 5, 1911. No. 19919 D.

Ornamental Castings Made in Permanent Molds. R. Hastings Probert. Details of practice are illustrated and described. 2000 w. Ir Age—Jan. 5, 1911. No. 19920 D.

See also Cast Iron, under MATERIALS OF CONSTRUCTION.

Gear Cutting.

Hobbing Helical or Spiral Gears. Instructions for setting up and running the Gould & Eberhardt gear hobber. 1800 w. Am Mach—Jan. 19, 1911. No. 20366.

Ins and Outs of Gear Hobbing. Ralph E. Flanders. An account of experiments carried out to obtain accurate information of the hobbing process of cutting gears, discussing the results. Ills. 5500 w. Mach, N Y—Jan., 1911. No. 19881 C.

The Production of Spiral Gears (Die Herstellung der Schraubenräder). W. Dohrn. A review of methods, with many practical numerical data. Ills. Serial. 1st part. 2900 w. Zeitschr f Werkzeug —Dec. 25, 1910. No. 20478 D.

Grinding.

Modern Abrasives. George N. Jeppson. Read before the Soc. of Auto Engrs. Illustrated discussion of grinding wheels and the abrasives used. 2000 w. Automobile—Jan. 19, 1911. No. 20355.

Grinding Machinery.

Grinding Machinery. C. H. Norton. Reviews the development and history of cylindrical grinding. 4500 w. Jour Cleveland Engng Soc—Dec., 1910. No. 20329 D.

The Pratt & Whitney Automatic Cylindrical Sizing Grinder. Illustrated description of a design producing rapid and accurate work. 2000 w. Ir Age—Jan. 5, 1911. No. 19912 D.

Machine Tools.

What Is a Machine Tool? T. S. Bentley. Discusses the use of the term, and the suggested definitions, advising concerted action. 3000 w. Mach, N Y—Jan., 1911. No. 19883 C.

Strength of the Counterweight Chain. Gives examples from every-day practice to analyze argued questions in machine design. Ills. 1700 w. Am Mach—Vol. 33. No. 51. No. 20218.

Schiess Machine-Tools. Illustrates and describes two large machines for turbine work, and a machine for punching teeth in saw-blades. 700 w. Engng—Jan. 13, 1911. No. 20515 A.

Metal Cutting.

See Welding, under MACHINE WORKS AND FOUNDRIES.

Milling.

See Cam Cutting, under MACHINE WORKS AND FOUNDRIES.

Milling Machines.

The Universal Milling Machines. Luther D. Burlingame. An illustrated account of how this machine was invented, its first uses and early successes. 2500 w. Am Mach—Jan. 5, 1911. No. 20226.

Molding.

The Making of Cast Steel Cable Drums. H. J. M'Caslin. Illustrates and describes the molding of winding drums on end and the method's possibilities in other lines of foundry work. 1500 w. Castings—Jan., 1911. No. 20280.

Molding Air-Cooled Cylinders. Illustrated detailed description. 600 w. Am Mach—Jan. 12, 1911. No. 20230.

Pattern Shops.

Wood-Drying Plants for Pattern Shops (Holztrockenanlagen für Modelltischlereien). F. A. Luhr. Discusses the lay-out and equipment of such plants and their cost. Ills. 2000 w. Giesserei-Zeit—Dec. 1, 1910. No. 20449 D.

Pipe Drawing.

A Modern Seamless Tube Manufacturing Plank. Plan and illustrated description of a new mill in Milwaukee, Wis. 2200 w. Ir Trd Rev—Jan. 26, 1911. No. 20626.

Pipe Founding.

The Continuous Manufacture of Cast Iron Pipe. A. O. Backert. A continuous molding and casting plant at Scottdale, Pa., is illustrated and described. 4500 w. Ir Trd Rev—Jan. 5, 1911. No. 19948 D.

See also Foundries, under MACHINE WORKS AND FOUNDRIES.

Pipe Manufacture.

Improved Machine for the Manufacture of Helically-Constructed Metallic Tube. Illustrates and describes improvements invented by Arthur Judge, including feed rollers and tapering rollers in the coiling chamber, the use of hot-air blasts for returning excess of solder to the bath, and a mechanism for cutting off tubes without stopping the travel. 1500 w. Prac Engr—Dec. 30, 1910. No. 20083 A.

Planers.

Manufacturing a Planer Feed Gear. F. A. Stanley. Illustrated description of a new form of feed gear for planers in which the parts are all self-contained and inclosed in the body of the device. 1500 w. Am Mach—Vol. 33. No. 52. No. 20222.

Pneumatic Machines.

Pneumatic Press for Removing Spring Bands. S. Wheal. Illustrated detailed description of machine designed and built at Springfield, Ill. 500 w. Mach, N Y—Jan., 1911. No. 19882 C.

Rivetting Machines.

The Production of Built-Up Members (Ueber die Herstellung eiserner Tragwerke). Describes machines for boring rivet holes and rivetting machines of various types. Ills. 6600 w. Oest Zeitschr f d Oeffent Baudienst—Dec. 31, 1910. No. 20485 D.

Sheet-Metal Working.

Forming Screw Conveyer Flights. Otto S. Beyer. Illustrated description of a method of solving a problem in sheet metal work. 1500 w. Am Mach—Jan. 12, 1911. No. 20231.

Shop Appliances.

Tools Used for Fire Engine Work. F. A. Stanley. Illustrates and describes useful tools and special appliances. 800 w. Am Mach—Jan. 19, 1911. No. 20369.

Some Jig and Fixture Designs. Franklin D. Jones. Illustrates and describes examples from the tool designing department of the Taft-Pierce Mfg. Co. 2500 w. Mach, N Y—Jan., 1911. No. 19884 C.

Shop Design.

Modern Machine Shops and Individual Plants. Charles Day. Last article of a series on the planning and building of industrial plants, illustrating and describing types and examples. 3000 w. Engineering Magazine—Feb., 1911. No. 20681 B.

Forge Shop Design and Arrangement. Warren H. Miller. Illustrated suggestions for efficiency. 1800 w. Am Mach—Vol. 33. No. 51. No. 20220.

Shop Practice.

Some Time-Saving Arrangements. W. Burns. Illustrates and describes practical shop devices and their uses. 1200 w. Cassier's Mag—Jan., 1911. No. 20305 B.

Die Work for Vacuum Cleaner Parts. S. B. Redfield. Illustrates and describes some of the many interesting dies and punches used to produce the parts. 1800 w. Am Mach—Vol. 33. No. 51. No. 20217.

Notes on Making Sheffield Cutlery. A. L. Haas. Describes primitive hand methods still used. 1200 w. Am Mach—Jan. 19, 1911. No. 20365.

Manufacture of a Bottle Cap. Illustrates and describes details of its production and attachment. 1500 w. Am Mach—Jan. 5, 1911. No. 20228.

Making Auto Motors and Parts. E. F. Lake. Illustrates and describes machinery methods in a Detroit shop. 1500 w. Am Mach—Jan. 19, 1911. No. 20364.

Building a Steam Fire Engine. F. A. Stanley. Illustrates and describes interesting construction work. 1800 w. Am Mach—Jan. 5, 1911. No. 20225.

A Vertical Boring-Mill Operation. Descriptive supplement and notes on the turning of a flywheel. 2000 w. Mach, N Y—Jan., 1911. No. 19885 C.

Shops.

Machine and Boiler Shops of Improved Construction. Illustrated description of features of recent additions to the plant of the York Mfg. Co., at York, Pa. 3500 w. Ir Age—Jan. 19, 1911. No. 20279.

Welding.

Metal-Cutting and Welding Blow-Pipes. Illustrates and describes appliances at Olympia Exhibition. 1200 w. Engng—Jan 6, 1911. No. 20264 A.

The Strength of Oxy-acetylene Welds in Steel. L. Whittemore. Abstract of a thesis describing work to ascertain their physical properties. Ills. 4000 w. Wis Engr—Jan., 1911. No. 20325 C.

See also Boiler Repairs, under STEAM ENGINEERING.

MATERIALS OF CONSTRUCTION.

Alloys.

Monel Metal and Its Uses. John F. Thompson. A natural alloy used for warship propellers, roofs of buildings, mine screens, etc. 1500 w. Eng & Min Jour—Jan. 28, 1911. No. 20645.

The Production of Castings to Withstand High Pressures. Prof. H. C. H. Carpenter and C. A. Edwards. An illustrated account of investigation of the production of castings of non-ferrous alloys capable of withstanding high pressures, whether hydraulic, steam, or gaseous. 10000 w. Inst of Mech Engrs—Dec. 16, 1910. No. 19971 N.

Bronzes.

Notes on Bronzes and Other Copper Alloys (Einiges über Bronzen und andere Kupferlegierungen). A. Rzehulka. Discusses their composition for various purposes, their properties, etc. 7800 w. Glasers Ann—Dec. 15, 1910. No. 20475 D.

Cast Iron.

Improved Cast Iron and How to Get It in the Foundry. F. P. Lewis. Read before the British Foundrymen's Assn. Discusses how the quality of cast iron may be improved and its use extended. 5000 w. Castings—Jan., 1911. No. 20282.

Heat Treatment.

Heat and Cooling Treatment. James H. Baker. Shows the benefits of iron and steel heat treatment, the principle underlying the process, suggestions as to appliances, etc. 4000 w. Am Mach—Jan. 5, 1911. No. 20227.

Malleable Iron.

Malleable Annealing Experiments. S. B. Chadsey. Illustrated report of tests made to ascertain the effect upon physical properties of malleables subjected to successive annealing. 2000 w. Foundry —Jan., 1911. No. 19904.

Metallography.

The Utility of the Metallographic Microscope in Engineering. James Arston. Discusses its use in the examination of steels and other industrial alloys, giving examples of its application to special problems. Ills. 2000 w. Wis Engr—Jan., 1911. No. 20326 C.

The Constitution of Troostite and the Tempering of Steel. Andrew McCance. Report of research work at the laboratories of the Royal School of Mines. Ills. 5000 w. Inst of Mech Engrs—Dec. 16, 1910. No. 19976 N.

Application of the Method of Thermic Analysis to Ternary Alloys (Application de la Méthode d'Analyse thermique aux Alliages ternaires). A. Portevin. An extension of the Tammann method to ternary alloys. Ills. 2500 w. Rev de Métal—Dec., 1910. No. 20407 E + F.

Steel.

Electro Steel. Joseph Schaeffers. Read before the Soc. of Auto. Engrs. Points out the characteristic of electricially refined steel from the viewpoint of an automobile engineer. Ills. 2500 w. Automobile—Jan. 12, 1911. No. 20192 C.

Wire Rope.

A Large Wire Rope of Unusual Construction for a Cable Incline of the Mayari R. R., Cuba. Frank W. Bunn. Detailed description of a rope 3 ins. in diameter. Ills. 1000 w. Eng News—Dec. 29, 1910. No. 19794.

MEASUREMENT.

Dynamometers.

Brake Dynamometers. Explains brake tests made for determining the effective horsepower of an engine. Ills. 2000 w. Mech Wld—Jan. 13, 1911. No. 20508 A.

Laboratories.

Laboratory of Ludwig Loewe & Co. Bertold Mitan. Describes the first laboratory established by a machinery-buiding firm in Europe. Ills. 2500 w. Am Mach—Jan. 26, 1911. No. 20603.

Lubricant Testing.

Testing of Lubricating Oils. David L. Gallup. Describes tests made with the Kingsbury oil testing machine, with particular reference to oils used in the automobile engine. Ills. 2000 w. Jour Worcester Poly Inst—Jan., 1911. No. 20320 C.

Pressure Indicator.

Pressure-Recording Indicator for Punching Machinery. Gardner C. Anthony. Describes a device for obtaining cards from an ordnance indicator applied to a pressure cylinder, which enables the operator to obtain results as easily and rapidly as in indicating an engine. Ills. 1000 w. Jour Am Soc of Mech Engrs—Jan., 1911. No. 20574 F.

Pyrometry.

Industrial Pyrometry. Charles R. Darling. Brief review of the history of temperature measurement with a study of modern pyrometers. Ills. 3500 w. Jour Soc of Arts—Dec. 23, 1910. No. 19953 A.

Checking Pyrometers in Service. R. W. Davenport. Describes the construction and operation of pyrometers, and means of detecting and correcting errors. 1500 w. Am Mach—Jan. 12, 1911. No. 20235.

Electric Pyrometers (Les Pyromètres électriques). H. Marchand. A review of the various types. Ills. 2700 w. L'Elecn—Dec. 17, 1910, No. 20419 D.

Steam Meters.

Exhibition and Description of Steam Meter. W. G. McKellar. Illustrated description, with discussion. 2000 w. Jour W of Scotland Ir & St Inst—Nov., 1910. No. 20311 N.

Stresses.

Photo-Elasticity. E. G. Coker. An illustrated report of experiments on the optical determination of stresses in bodies and built-up structures. Plate. 6000 w. Engng—Jan. 6, 1911. No. 20260 A.

Testing Machines.

A New Impact Testing-Machine. D. R. MacLachlan. Illustrated description of a machine for testing materials by direct tension, suddenly applied, recently completed at the Woolwich Polytechnic. 1500 w. Engng—Dec. 23, 1910. No. 19974 A.

Torsion Meters.

The Eotvos-Hecker Torsion-Balance. Diagrams and description of this instrument. 2000 w. Engng—Jan. 13, 1911. No. 20516 A.

Water Meters.

The Woltmann Water Meter (Der Woltmann-Wassermesser). Herr Hache. Describes the meter and reports results of tests. Ills. 3600 w. Zeitschr d Ver Deutscher Ing—Dec. 31, 1910. No. 20709 D.

POWER AND TRANSMISSION.

Air Compressors.

See Engine Design, under STEAM ENGINEERING.

Costs.

Graphical Representation of Power Costs (Graphische Veranschaulichung der Rentabilität von Maschinen). H. Goetz. A graphical comparison of direct and indirect costs for electric motors and gas and oil engines for various periods of operation. Ills. Serial. 1st part. 2000 w. Zeitschr f Werkzeug—Dec. 15, 1910. No. 20477 D.

Electric Driving.

Electrical Driving of Engineering Workshops. C. L. Browne. The advantages and disadvantages are discussed, as compared with mechanically driven shops. 1800 w. Mech Wld—Jan. 6, 1911. Serial. 1st part. No. 20257 A.

Electricity in the Machine Shop. C. W. Johnson. Read before the Met. Trds. Supts. & Foremen's Club. Information concerning its applications and the savings expected by its use. 3000 w. Ir Age—Jan. 26, 1911. No. 20600.

Trend of Electric Power Application in the Iron and Steel Industry. R. Tschentscher. Discusses the trend of future development in electric application, sources of waste heat, etc. 1500 w. Elec Rev & W Elect'n—Jan. 7, 1911. No. 20052.

Electric Driving of Textile Machinery. Illustrated description of the power plant of the Ray Mills, at Stalybridge. 2000 w. Elec Rev, Lond—Dec. 23, 1910. No. 19959 A.

Recent Developments in Textile Mill Design and Operation: Notably as Regards Electrification. L. Crouch. Notes on four groups of American textile mills, representing a total capacity of 17,000 kw., driving some 528,000 spindles and 19,400 looms. 2200 w. Elec Rev, Lond—Dec. 23, 1910. Serial. 1st part. No. 19958 A.

Gas Power.

Gas Power Development. James Rowland Bibbins. Reviews what has been accomplished, and discusses the future applications in undeveloped fields. 4500 w. Jour Am Soc of Mech Engrs—Jan., 1911. No. 20575 F.

Some Pertinent Features Relating to Gas Power. E. D. Dreyfus. Discusses the fundamental features, the fields of usefulness, the gases for operation, types of gas engines, etc. Ills. 7000 w. Pro Ry Club of Pittsburgh—Nov. 25, 1910. No. 20318 C.

Lubricants.

See Lubricant Testing, under MEASUREMENT.

Lubrication.

The Lubrication of Ball Bearings. W. L. Batt. Discusses the requirements, and illustrates examples of mountings for ball bearings designed to retain lubricants. 1500 w. Am Mach—Jan. 12, 1911. No. 20236.

See also Turbine Lubrication, under STEAM ENGINEERING.

Power-Plant Records.

Keeping Power Plant Records. Warren O. Rogers. Illustrates and describes a complete system of daily, weekly, and monthly reports. 1500 w. Power—Jan. 24, 1911. No. 20390.

Power Plants.

Features of Plant at Kodak Park Works. A. R. Maujer. Brief description of interesting features of this plant at Rochester, N. Y. Ills. 1200 w. Power—Jan. 17, 1911. No. 20213.

See also Steel, under CIVIL ENGINEERING, CONSTRUCTION; and Isolated Plants, under ELECTRICAL ENGINEERING, GENERATING STATIONS.

Wave Motors.

New Wave Motor of the Float Type. A. R. Maujer and Franklin Van Winkle. An estimate of the U. S. Wave Power Co.'s motor installed on Young's "Million-dollar" pier, at Atlantic City, N. J. Ills. 2500 w. Power—Jan. 17, 1911. No. 20215.

Windmills.

A Nantucket Windmill of 1746 Still in Operation. Allen Day. Illustrated account of how the Dutch windmill was introduced into New England, with description of the mill mentioned. Ills. 1500 w. Sci Am—Jan. 28, 1911. No. 20640.

STEAM ENGINEERING.

Boiler Design.

See Steam Boilers, under MARINE AND NAVAL ENGINEERING.

Boiler Economy.

Boiler Economics and the Use of High Gas Speeds. Prof. John T. Nicolson. Gives an account of results obtained with an experimental boiler, discussing the bearing of the newly-obtained data on boiler practice. Ills. 19600 w. Inst of Engrs & Shipbldrs in Scotland—Dec. 20, 1910. No. 20525 N.

Boiler Explosions.

Water Hammer and Boiler Explosions. A. Vincent Clark. Gives theories of the cause of such explosions, explaining their violence. 1700 w. Power—Jan. 10, 1911. No. 20103.

Boiler Firing.

Stoking with Cheap Fuel. G. Basil Barham. Suggestions for successful stoking with various cheap fuels. 2000 w. Elec Engr, Lond—Jan. 6, 1911. No. 20245 A.

Boiler Management.

Increasing the Capacity of Boilers. H. R. Callaway. Explains how the capacity of a horizontal boiler may be increased approximately 300 per cent. 1700 w. Power—Jan. 24, 1911. No. 20392.

Notes and Comments on Boiler Working. C. E. Stromeyer. From the memorandum of the Chief Engr. of the Manchester Steam Users' Assn. for the year 1909. 6000 w. Mech Engr—Dec. 30, 1910. Serial. 1st part. No. 20086 A.

Hudson Manhattan Power Station. F. R. Low. Illustrates and describes the boiler-room practice in this Jersey City plant which produces current for the operation of the trains in the McAdoo tunnels at less than 0.42 of a cent per kw-hour and makes 1000 lbs. of steam with 12.5 cents worth of coal. 1700 w. Power —Jan. 17, 1911. No. 20212.

Boiler Repairs.

Flue Welding in Repairing Boilers. H. S. Jeffrey. Tells how to weld boiler tubes which are cut during the process of removal. Ills. 1100 w. Power—Jan. 17, 1911. No. 20216.

Boiler Settings.

Setting Horizontal Tubular Boilers. S. F. Jeter. Gives directions for constructing the setting, and dimensions of different parts of the setting for various sizes of boilers. Ills. 4000 w. Power—Jan. 3, 1911. No. 19886.

Boiler Tubes.

Stresses in Tubes. Prof. Reid T. Stewart. An investigation showing that the stresses in the wall of a tube exposed to an external fluid pressure are of the same character as those in a column having fixed ends. Mathematical. 1800 w. Jour Am Soc of Mech Engrs—Jan., 1911. No. 20572 F

Boiler Washing.

See Locomotive Boilers, under RAILWAY ENGINEERING, MOTIVE POWER AND EQUIPMENT.

Condensers.

Jet v. Surface Condensers. R. M. Neilson. Considers the surface condenser and the barometric jet condenser, aiming to show where each may be profitably employed in conjunction with steam turbines employing either high- or low-pressure steam. 3500 w. Engr, Lond—Dec. 23, 1910. No. 19977 A.

Notes on Condensing. Types of condensers are explained and the principles of operation which are essential for efficient running. 2000 w. Mech Wld—Jan. 6, 1911. Serial. 1st part. No. 20255 A.

Recent Types of Condensers (Neuere Condensator-Typen). Fr. Bock. Describes recent advances in European condenser design. Ills. Serial. 1st part. 1500 w. Elektrotech Rundschau—Dec. 22, 1910. No. 20490 D.

Economizers.

Economizer Utility. Abstract translations giving the main substance of papers by Herr Kaufhold, and Herr M. R. Schulz. Ills. 2500 w. Engr, Lond—Dec. 30, 1910. No. 20096 A.

Engine Compression.

The Effect of Compression on the Economy of the Steam Engine. R. C. Carpenter. Considers the theoretical and actual effects of compression, reporting tests and giving diagrams. 4500 w. Sib Jour of Engng—Dec., 1910. No. 20336 C.

Compression in Steam Engines. Armand Duchesne. Discusses the effect of compression on efficiency. 2000 w. Power —Jan. 10, 1911. No. 20106.

Engine Cylinders.

The Influence of the Cylinder Wall. Prof. V. Dwelshauvers-Dery. Shows that the thermal influence of the cylinder walls depends very little upon the size of the machine and very much on the conditions of operation. 3500 w. Power—Jan. 3, 1911. No. 19890.

Engine Design.

Engine and Compressor Power Charts. T. M. Chance. Gives three charts for determining the required dimensions for a given power, or vice versa, of a steam or gas engine, or air compressor. 1100 w. Power—Jan. 17, 1911. No. 20214.

Engine Reheaters.

Engines with Reheaters. A. C. Wilson. Read before the Manchester Univ. Engng. Soc. Deals with compressed steam engines arranged for imparting heat to the working fluid after it has done work in the high-pressure cylinder. Reports tests and conclusions. 3000 w. Mech Engr—Dec 23, 1910. No. 19964 A.

Engines.

600- I. H.-P. Compound Engine. Illustrated description of an engine fitted with Carels balanced drop-valves, and designed for limited space. Plate. 600 w. Engng—Dec. 30, 1910. No. 20092 A.

Engine Valve Gears.

A Slowly Moving Positive Valve Gear. Dr. Alfred Gradenwitz. Illustrated description of an engine having separate steam and exhaust valves of the piston type arranged tangentially to the cylinder and operated by eccentrics on a lay shaft. 1500 w. Power—Jan. 10, 1911. No. 20102.

A Geometrical Study of the Corliss Valve Gear (Etude géométrique de la Distribution des Machines à Vapeur à Distributeurs séparés). L. Letombe. A complete solution of gears of this type by means of rule and compass. Ills. 2800 w. Mem Soc Ing Civ de France—Oct., 1910—No. 20401 G.

Fuel Purchasing.

The Purchase of Coal by the Government Under Specifications, with Analyses of Coal Delivered for the Fiscal Year 1908-9. George S. Pope. Shows the results of government purchases according to specifications as to quality, with general information. 17500 w. U S Bureau of Mines—Bul II. No. 20672 N.

Mechanical Stokers.

Automatic Stokers Which Throw Coal. F. R. Low. Illustrated descriptions of various types used in Europe. 1800 w. Power—Jan. 24, 1911. No. 20391.

Oil Separators.

Separation of Oil from Condenser Water by Electrolysis. Ridsdale Ellis, Abstract of paper read before the Soc. of Chem. Ind. Describes the Davis-Perrett oil separator, giving particulars of the efficiency and cost of operation. Discussion. 2800 w. Elect'n, Lond—Dec. 30, 1910. No. 20081 A.

Plant Design.

Design of Steam Power Plants. William F. Fischer. Discusses the factors to be considered. 2000 w. Power—Jan. 24, 1911. No. 20393.

Smoke Prevention.

Smoke Prevention. General discussion. 7000 w. Pro Engrs' Club of Phila—Jan., 1911. No. 20578 D.

Smoke and Its Prevention. Vivian B. Lewes. A lecture delivered at the London Inst. Explains details of the chemical and physical action during combustion of bituminous coal, and the causes that give rise to smoke, reviewing the proposals made for its prevention. Considers the best solution is low-temperature carbonization and the production of such fuels as coalite. 7000 w. Nature—Dec. 29, 1910. No. 20072 A.

Device for Preventing Smoke. W. H. Odell. Illustrated description of a device using a hot blast to aid in the combustion of the fuel. 1200 w. Power—Jan. 10, 1911. No. 20105.

Needle Jets of Superheated Steam to Prevent Smoke: the Luckenbach Boiler Furnace. Illustrated description of the Luckenbach system. 800 w. Eng News—Dec. 29, 1910. No. 19795.

Investigations of Smokeless Combustion in the Karlsbad Municipal Plants (Versuche mit rauchschwachen Feuerungen in den städtischen Betrieben in Karlsbad). Rud. Grund. A brief review of the experience of the last 5 years. Ills. 2200 w. Oest Zeitschr f d Oeffent Baudienst—Dec. 10, 1910. No. 20483 D.

Stacks.

See same title, under CIVIL ENGINEERING, CONSTRUCTION.

Steam Piping.

A Simple Method of Determining Sizes of Pipes for Low-Pressure Steam-Heating. F. E. Giesecke. Diagrams and explanation, illustrated by problems, and giving related information. 3500 w. Dom Engng—Jan. 14, 1911. No. 20117.

Superheaters.

Modern Steam Superheaters. Warren O. Rogers. General illustrated description of American superheaters, dealing with features of design and application. 3500 w. Power—Jan. 3, 1911. No. 19888.

Turbine Bibliography.

Turbine Literature in 1909 (Jahreszeitschriftenschau von 1909). Herr Niemann. A bibliography of turbine literature in 198 publications, covering steam, water and gas turbines, centrifugal pumps and compressors, fans, and rotary engines. Serial. 1st part. 9600 w. Zeitschr f d Gesamte Turbinenwesen—Dec. 20, 1910. No. 20469 D.

Turbine Blades.

Tests and Experience with Turbine Blades in the German Navy (Versuche und Erfahrungen mit Turbinenschaufeln in der deutschen Kriegsmarine). Herr Schulz. A complete exposition of blade practice and of the knowledge gained. Ills. Serial. 1st part. 9000 w. Die Turbine—Dec. 5, 1910. No. 20465 D.

Turbine Governing.

The Governing of Steam Turbines (Die Regulierung von Dampfturbinen). Describes the methods and devices used for governing A. E. G. turbines. Ills. Serial. 1st part. 1400 w. Zeitschr f d Gesamte Turbinenwesen—Dec. 20, 1910. No. 20468 D.

Turbine Losses.

The Steam Turbine in Germany. F. E. Junge and E. Heinrich. A study of the losses which occur in turbines of the Curtis and Rateau types. Ills. 2000 w. Power—Jan. 3, 1910. No. 19889.

Turbine Lubrication.

Gravity Turbine Oiling System. Hugh Hughes. Illustrates and describes the design and operation of a system for the Curtis vertical turbine. 1800 w. Power—Jan. 3, 1911. No. 19887.

Turbines.

The Steam Turbine in Germany. F. E. Junge and E. Heinrich. Discusses combination turbines built on Curtis and Rateau principles. Ills. 1600 w. Power—Jan. 10, 1911. No. 20104.

5000-Kilowatt Rateau Steam Turbines at the Greenwich Power Station. Drawings and description. 3500 w. Engng—Jan. 13, 1911. No. 20511 A.

Advantages, Operating Conditions, and Applications of Small Exhaust Steam Turbines. A. Eugene Michel. Illustrates and describes a Kerr exhaust turbine generator installation, explaining its advantages. 2200 w. Can Engr—Dec. 29, 1910. No. 19850.

TRANSPORTING AND CONVEYING.

Cableways.

Cableways Built by the Peniger Maschinenfabrik und Eisengiesserei A. G. (Kabelhochbahnkrane gebaut von der Peniger Maschinenfabrik und Eisengiesserei A.-G.). M. Buhle.. Describes a type of single-span cableway. Ills. 3000 w. Zeitschr d Ver Deutscher Ing—Dec. 31, 1910. No. 20710 D.

See also Coal Handling, under TRANSPORTING AND CONVEYING.

Coal-Handling.

Electricity in Gas Works. Dr. Alfred Gradenwitz. Illustrates and describes the application of electric motors to coal-handling machinery. 800 w. Sci Am Sup—Dec. 31, 1910. No. 19790.

Transporting Methods in Modern Coal Mines. Dr. Alfred Gradenwitz. Illustrates and describes some model plants using electric cableways. 2000 w. Min Wld—Jan. 7, 1911. No. 20064.

Cranes.

25-Ton Steam Travelling Crane. Illustrated description of a crane for harbor works at Singapore. 500 w. Engng—Jan. 13, 1911. No. 20513 A.

Magnet Cranes (Magnetkrane). C. Michenfelder. Describes a number of steel-works and foundry magnet cranes. Ills. 6000 w. Zeitschr d Ver Deutscher Ing—Dec. 3, 1910. No. 20703 D.

Elevators.

The Accurate Stopping of Elevators (Ueber das genaue Halten der Fahrstühle). Carl Gruber. Discusses means for bringing elevators gently and accurately to rest at all loads. Ills. Serial. 1st part. 2200 w. Elektrotech Rundschau—Dec. 29, 1910. No. 20491 D.

Freight Handling.

The Mechanical Handling of Freight. Samuel B. Fowler. Full discussion of the problem showing its effect on the whole transportation question, its cost and efficiency. 8800 w. Jour Am Soc of Mech Engrs—Jan., 1911. No. 20571 F.

See also Steel, under CIVIL ENGINEERING, CONSTRUCTION.

Hoisting Machinery.

Electrically Operated Hoisting Machinery (Les Appareils de Levage à Commande électrique). G. Dehenne. Considers the advantages of electrical operation for hoisting machinery of all types, reviewing present practice. Ills. 1200 w. Mem Soc Ing Civ de France—Oct., 1910. No. 20400 G.

Lifting Magnets.

The Practical Application of Lifting Magnets. H. F. Stratton. Discusses the design and construction of magnets, referring to the character of the service they encounter. Ills. 3000 w. Sib Jour of Engng—Dec., 1910. No. 20334 C.

See also Cranes, under TRANSPORTING AND CONVEYING.

Mail Handling.

Mail-Handling Plant at the Pennsylvania Terminal. Joseph B. Baker. Illustrates and describes a unique electric-diriven mechanical-transport installation. 3500 w. Engineering Magazine—Feb., 1911. No. 20680 B.

Mail-Handling Plant in a New York Post Office. Joseph B. Baker. Illustrated description of the electrically operated plant in the Pennsylvania R. R. Station, handling nearly 300 tons of mail daily. 3000 w. Elec Rev & W Elect'n—Jan. 21, 1911. No. 20382.

MISCELLANY.

Guns.

The Stiffness of Guns. H. J. Jones. A study of the comparative stiffness of modern built-up, solid and wire-wound guns, and the initial unsteadiness of projectiles. 4000 w. Engng—Dec. 30, 1910. No. 20090 A.

Special Artillery for Attacking Airships and Aeroplanes (L'Artillerie spéciale contre les Dirigeables et les Aéroplanes). G. Espitallier. Describes guns and projectiles developed for this purpose in France. Ills. 3500 w. Génie Civil—Dec. 17, 1910. No. 20428 D.

Paper-Making Machinery.

A Large Paper-Making Machine. F. C. Coleman. Illustrations and brief description of machinery recently made for the paper mills of the "Daily Telegraph" of London. 1500 w. Sci Am Sup—Jan. 7, 1911. No. 19943.

Recording Clocks.

Time-Recording and Signalling Apparatus. An illustrated review of the leading types of instruments of this kind on the markets. 500 w. Mech Engr—Dec. 23, 1910. Serial. 1st part. No. 19963 A.

Vacuum Cleaning.

Vacuum Cleaning in Federal Buildings M. S. Cooley and Nelson S. Thompson. Describes the stationary vacuum cleaning systems used in post office and othe treasury department buildings. 2000 w Met Work—Jan. 7, 1911. Serial. 1st part. No. 19988.

MINING AND METALLURGY

COAL AND COKE.

Accidents.

Fatal Accidents in the Coal Mines of North America. Frederick L. Hoffman. Gives statistics and discusses the improvements needed to lessen the fatalities. 3000 w. Eng & Min Jour—Dec. 31, 1910. No. 19866.

Australia.

Ipswich Coal and Coke Syndicate's Property, Tivoli, Near Ipswich. W. E. Cameron. Map and description of coal deposits in Queensland. 1500 w. Queens Gov Min Jour—Dec. 15, 1910. No. 20243 B.

New South Wales Collieries and Electricity. E. Kilburn Scott. Abstract of paper read before the Assn. of Min. Elec. Engrs. Information concerning the colliery districts and their mining methods, and the inquiry into the use of electricity. 5000 w. Elec Engr, Lond—Jan. 13, 1911. No. 20398 A.

British Columbia.

The Classification of Nicola Valley Coals. S. J. Castleman. Gives reports of analyses made and coking quality which show them to be bituminous coals. 700 w. Qr Bul of Can Min Inst, No. 12—Oct., 1910. No. 20535 N.

Cape Breton.

Dominion No. 2 Colliery of the Dominion Coal Company. A. G. Haultain. Describes mining methods on Cape Breton Island. Ills. 3000 w. Qr Bul of Can Min Inst, No. 12—Oct., 1910. No. 20539 N.

Coking Plants.

A New By-Product Coking Plant in the South. The modern method of coke-making at the Woodward Iron Company's works is illustrated and described. 3500 w. Ir Trd Rev—Jan. 5, 1911. No. 19951 D.

Drying.

See same title, under ORE DRESSING AND CONCENTRATION.

Electric Power.

Electricity Applied to Mining. C. F. Jackson. Lecture delivered before the Coventry Eng. Soc. Briefly considers the applications of electric power in mines. 2000 w. Ir & Coal Trds Rev—Jan. 6, 1911. No. 20275 A.

The Earthed Concentric System for Direct-Current Colliery Cables. W. Bolton Shaw. Read before the Inst. of Min. Elec. Engrs. Presents the advantages of this system and discusses the precautions to be observed when installing it. 4000 w. Mech Engr—Jan. 6, 1911. No. 20253 A.

The Use of "Earth" in Connection with Electricity in Mining. Sydney F. Walker. The present article discusses the question of earthing with continuous-current supply service. 2000 w. Ir & Coal Trds Rev—Jan. 6, 1911. Serial 1st part. No. 20274 A.

Flame-Proof Motors for Colliery Work. Illustrated description of a motor specially designed for mining requirements. 600 w. Engng—Jan. 6, 1911. No. 20267 A.

Production and Utilization of Electrical Energy at the Lens Mines (Production et Utilisation de l'Energie électrique aux Mines de Lens). M. Besson. Describes the use of coke-oven gas under boilers and in gas engines, and the utilization of exhaust steam. Ills. 5600 w. Bul Soc Int d'Elecns—Dec., 1910. No. 20403 F.

See also Australia, under COAL AND COKE.

Explosions.

Coal-Dust Explosions. Comments on research work, particularly in France, and the conclusions thus far reached. 4500 w. Engng—Jan. 6, 1911. No. 20266 A.

The Delagua, Colo., Explosion. George F. Duck. An illustrated account of conditions at the mine before and after the explosion. 5000 w. Mines & Min—Jan., 1911. No. 19901 C.

Great Britain.

The Nottingham Coalfield. Information from a memoir on the geology of the country recently issued by the Geological Survey. 5000 w. Col Guard—Dec. 30, 1910. No. 20089 A.

Illinois.

The Illinois Coal Industry. Frank W. DeWolf. Review of the past year, the strike, etc. 1500 w. Min & Sci Pr—Jan. 7, 1911. No. 20153.

Mine Drainage.

Draining a Flooded Goaf. J. R. Wilkinson. Read before the Nat. Assn. of Col. Mgrs. An illustrated account of an experience resulting in failure. 2000 w. Ir & Coal Trds Rev—Jan. 6, 1911. No. 20273 A.

Mine Dust.

The British Coal-Dust Experiments. Editorial review of the experiments carried out on behalf of the Mining Assn. of Gt. Britain. 3000 w. Engng—Dec. 23, 1910. No. 19975 A.

Coal Dust Experiments. Sir Henry Hall. Abstract of a paper read before the Manchester Geol. & Min. Soc. Comments on the recent British, Continental and American coal dust experiments. 6000 w. Ir & Coal Trds Rev—Jan. 13, 1911. No. 20524 A.

French Experiments on Coal Dust. Henry Briggs. A discussion of the results of these experiments. 4000 w. Eng & Min Jour—Jan. 21, 1911. No. 20363.

Coal-Dust Experiments in Austria. A detailed summary of a report of the second series of experiments in the Rossitz gallery, with editorial comment. Ills. 3000 w. Col Guard—Dec. 30, 1910. No. 20088 A.

Mine Lighting.

The Installation of Electric Lighting in Collieries. P. D. Coates. An outline of what the writer considers the best method of procedure. 1500 w. Ir & Coal Trds Rev—Jan. 6, 1911. No. 20276 A.

Mining.

American vs. European Mining. Dr. Henry M. Payne. Address before the Appalachian Engng. Assn. A comparison of methods in the European countries with American methods. 1800 w. Mfrs' Rec—Jan. 5, 1911. No. 19993.

Mining Law.

The Mine Law of West Virginia. P. A. Grady. Read before the W. Va. Coal Min. Inst. Shows that those most successful in the production of coal do better than the law requires. 3000 w. Mines & Min—Jan., 1911. No. 19900 C.

Pennsylvania.

Model Coal Mines at Marianna. A. C. Beeson and Floyd W. Parsons. First of a series of articles giving detailed descriptions of most modern coal operation in America. Ills. 2000 w. Eng & Min Jour—Jan. 21, 1911. Serial. 1st part. No. 20361.

Prospecting.

Prospecting for Coal Above Water Level. Baird Halberstadt. Abstract from Trans. of the Appalachian Engng. Assn. Describes methods of prospecting, using a drill auger. 2500 w. Min Wld—Jan. 7, 1911. No. 20067.

Rescue Methods.

The History of Rescue Methods in Coal Mining (Beiträge zur Geschichte des bergmännischen Rettungswesens). Herr Hagemann. A review of the early history of rescue apparatus in England and Germany. 4200 w. Glückauf—Dec. 24, 1910. No. 20457 D.

Review of 1910.

The Coal and Coke Industry in 1910. Articles by reliable authors dealing with that industry, trade, production, etc. 9000 w. Eng & Min Jour—Jan. 7, 1911. No. 20048.

The Coal-Mining Industry of the U. S. in 1910. Edward W. Parker. A report on production of anthracite and bituminous coal. 4000 w. Min Wld—Jan. 21, 1911. No. 20376 C.

Screening.

The Design of Screening Plants for Old and Modern Collieries. J. S. Barnes. Illustrates and describes a plant recently designed by the writer, aiming to secure economy and efficiency. Plate. 1500 w. Engr, Lond—Dec. 23, 1910. Serial. 1st part. No. 19979 A.

Trade.

The Coal Trade in 1910. A general review by districts. Also editorial. 32500 w. Col Guard—Jan. 6, 1911. Serial. 1st part. No. 20258 A.

The Coal, Iron and Allied Trades in 1910. General and district reviews of the year's progress in these industries. 27500 w. Ir & Coal Trds Rev—Dec. 30, 1910. No. 20100 A.

Wales.

The Main Collieries, Neath. History and description. 3500 w. Ir & Coal Trds Rev—Jan. 13, 1911. No. 20523 A.

COPPER.

Alaska.

Opening of the Chitina Copper Belt in Alaska. Denis Donohoe. An illustrated account of a richly mineralized region, yielding copper, free gold, and auriferous stibnite. 2000 w. Eng & Min Jour—Dec. 31, 1910. No. 19863.

Arizona.

The Ray Copper Mining District, Arizona. Walter Harvey Weed. An illustrated description of the development of low-grade deposits. 3500 w. Min Wld—Jan. 14, 1911. No. 20208.

California.

The Copper Smelting Situation in California. A. H. Martin. Discusses the decline due to the anti-smoke agitation against smelters. 3000 w. Min Wld—Jan. 7, 1911. No. 20065.

Converters.

A New Copper Converter. Illustrated description of a converter of the Pierce-Smith type. 800 w. Aust Min Stand—Nov. 23, 1910. No. 20069 B.

Metallurgy.

Review of the Metallurgy of Copper in 1910. L. S. Austin. Reviews present practice in conveying and transmission, roasting, reverberatory smelting, blast furnace operation, converter practice, etc. 3000 w. Met & Chem Engng—Jan., 1911. No. 20131 C.

The Metallurgy of Copper in 1910. Arthur L. Walker. Reviews some important developments in reverberatory practice, flue dust, smoke, refining, etc. 2500 w. Eng & Min Jour—Jan. 7, 1911. No. 20038.

Prices.

Copper Prices and the Future of the Industry. Martin E. Tew. Brief review of past and present conditions, predicting higher prices. 2000 w. Min Wld—Jan. 19, 1911. No. 20374 C.

Review of 1910.

The Copper Industry in 1910. Statistics of production, consumption, and related matter. Also articles on the more important mines, by well known engineers. 10000 w. Eng & Min Jour—Jan. 7, 1911. No. 20033.

Review of the World's Copper Trade in 1910. Horace J. Stevens. A review of production and prices. 3500 w. Min Wld—Jan. 21, 1911. No. 20372 C.

Production of Copper in the United States in 1910. A review by states. 1800 w. Min Wld—Jan. 21, 1911. No. 20373 C.

Copper Production in 1910 by States. Shows an output below 1909, but exceeding any other year. 1500 w. Min & Sci Pr—Jan. 14, 1911. No. 20293.

Slags.

Notes on Metal Losses in Copper Slags. Thomas Kiddie. Gives results of slag analyses. 1000 w. Qr Bul of Can Min Inst, No. 12—Oct., 1910. No. 20529 N.

Smelting.

Improvements in Silver-Lead and Copper Smelting. L. S. Austin. Reviews the advances of the past year in blast-roasting of silver-lead ores, and lessening the annoyance of smoke; and the development of basic converting in copper smelting. 3000 w. Min & Sci Pr—Jan. 7, 1911. No. 20156.

Trade.

The Copper Trade in 1910. L. M. Atherton. Reviews a disappointing year. 1800 w. Ir Age—Jan. 5, 1911. No. 19917 D.

Utah.

Notes on Some Utah Mines. Edward R. Zalinski. Map, with information concerning various camps. 2200 w. Eng & Min Jour—Jan. 28, 1911. No. 20644.

GOLD AND SILVER.

Alaska.

See same title, under Copper.

Amalgamation.

Amalgamation Following Fine Grinding. C. F. Spaulding. Describes an amalgamating device to be used with fine grinding. 1100 w. Min & Sci Pr—Dec. 31, 1910. No. 19997.

Assaying.

A Portable Assay-Outfit for Field-Work. Describes outfit and supplies for about 100 assays which could be carried in a 26-in. valise. 2500 w. Bul Am Inst of Min Engrs—Jan., 1911. No. 20581 F.

Australia.

The Meekatharra Gold Mining Centre, Western Australia. H. P. Woodward. Information of the Kyarra mine district. 1500 w. Aust Min Stand—Nov. 30, 1910. No. 20070 B.

British Columbia.

In and About Stewart, B. C. W. W. Rush. Illustrated account of progress in the Portland Canal district. 1500 w. Can Min Jour—Jan. 15, 1911. No. 20353.

Silver and Gold Deposits on the West Fork of Kettle River, B. C. L. Reinecke. Brief description of the more striking features of the silver-lead deposits on Wallace Mountain, and the gold-silver property, on the West Fork of the Kettle River. 2200 w. Qr Bul of Can Min Inst, No. 12—Oct., 1910. No. 20534 N.

Portland Canal. Newton W. Emmens. Describes this district, giving its history, geology, and describing the more prominent mines and prospects. Ills. 8000 w. B C Min Rec—Nov., 1910. No. 19991 C.

Portland Canal Mining Division. Notes from the preliminary report by William Fleet Robertson. Descriptive review of this mining district and its development. 6000 w. Can Min Jour—Jan. 1, 1911. No. 19894.

California.

Gold Mining in California in 1910. William H. Storms. Illustrated review of the year, reporting a noticeable revival. 2000 w. Min & Sci Pr—Jan. 7, 1911. No. 20150.

Cobalt.

Review of Mining in Cobalt During 1910. Reviews the production of the different properties and the discoveries made during the year. Map. 3800 w. Can Min Jour—Jan. 15, 1911. No. 20352.

Output of the Coniagas Mines, Ltd., 1910. Alex. Gray. Plan, flow sheet, and report of the output of silver for the year, with other information. 1500 w. Min Wld—Jan. 7, 1911. No. 20066.

Colorado.

Gold Deposits at San Juan, Colo. Warren C. Prosser. Map and description of the geology of the country, and some of the veins and mines. 3500 w. Mines & Min—Jan., 1911. No. 19897 C.

Mining in Cripple Creek District. William H. Storms. Information concerning the mines and their development. Ills. 2000 w. Min & Sci Pr—Jan. 21, 1911. No. 20628.

Cyaniding.

Review of Cyanidation in 1910. Philip Argall. Shows an advance along mechanical lines. 5000 w. Eng & Min Jour—Jan. 7, 1911. No. 20039.

Progress in Cyaniding During 1910. R. W. Gordon. Reviews improvements in details and methods resulting in reduction of cost and increase in production. 1500 w. Engng-Con—Jan., 1911. No. 20133 C.

American Progress in Cyanidation. A review of the past year showing an increased use of Pachuca vats and the process of continuous agitation, a tendency to downward heavier crushing duty, and increase in the practice of cyaniding the sulphides and vein material in the same operation. 2500 w. Min & Sci Pr—Jan. 7, 1911. No. 20157.

The Clancy Process. J. C. Clancy. Abstract of a paper the Am Elec. Chem. Soc. Describes the method of using this process for the treatment of refractory ores. 2800 w. Min & Sci Pr—Dec. 31, 1910. No. 19994.

Dredging.

Future of Dredging. Charles Janin. Briefly reviews dredging operations in various countries, and discusses future prospects. 3500 w. Min & Sci Pr—Dec. 31, 1910. No. 19995.

Gold Dredging in California. Charles Janin and W. M. Winston. Maps and review of the work during 1910. 1500 w. Min & Sci Pr—Jan. 7, 1911. No. 20154.

Nome Dredges in 1910. T. M. Gibson. Illustrates and describes dredges constructed during the past year, and the work they are expected to accomplish. 5500 w. Min & Sci Pr—Jan. 7, 1911. No. 20147.

New Klondike Dredges. Guy A. R. Lewington. Illustrates and describes Canadian No. 2, the largest gold dredge operating in the world. 1800 w. Min & Sci Pr—Jan. 7, 1911. No. 20149.

Type No. 1 of the New Era Gold Dredge. E. S. Bennett. Illustrated description. 1200 w. Min Wld—Jan. 28, 1911. No. 20665.

Hydraulic Mining.

Losses in Hydraulic Mining. Charles S. Haley. The difficulty of saving flaky gold, with suggestions. 1500 w. Min & Sci Pr—Jan. 21, 1911. No. 20629.

Manchuria.

Northern Manchuria. C. W. Purington. Map and general information concerning the country, its industries, gold deposits, etc. Ills. 3500 w. Mining Mag —Jan., 1911. No. 20596 B.

Mexico.

The Hostotipaquillo District, Jalisco, Mexico. Austin C. Brady. An account of the transmission of electric power to this district and its use in the mines. Ills. 1600 w. Min Wld—Jan. 7, 1911. No. 20068.

Deep Mining in the Guanajuato District, Mexico. Frank H. Probert. Illustrated description of the Nueva Luz shaft 2031 ft. deep. 1800 w. Eng & Min Jour —Dec. 31, 1910. No. 19865.

Nevada.

The Tonopah District in 1910. Herbert Haas. Review of the year, reporting an increase in production of the precious metals. 1500 w. Eng & Min Jour —Jan. 14, 1911. No. 20188,

Development of the Goldfield Mines. Claude T. Rice. Describes the present condition of the mines, giving information of the ore, methods of working, etc. 4000 w. Eng & Min Jour—Jan. 14, 1911. No. 20186.

Geology of the Jarbidge Mining District. Nelson W. Sweetser. Information concerning the geology and mineralization of this Nevada district. 1000 w. Min & Sci Pr—Dec. 31, 1910. No. 19996.

Ontario.

Montreal River Output and Prospects. Alex. Gray. A report of the Montreal River prospects and their development. 1200 w. Min Wld—Jan. 14, 1911. No. 20209.

The New Goldfields of Porcupine, Ontario. Reginald E. Hore. Illustrated account of the general character of this gold field and information related. 1200 w. Eng & Min Jour—Dec. 31, 1910. No. 19861.

Review of 1910.

The World's Gold and Silver Production in 1910. Statistical review. 3500 w. Min & Sci Pr—Jan. 7, 1911. No. 20154.

Gold, Silver and Platinum in 1910. Frederick Hobart. Statistics on the production and movement of these metals. 3500 w. Eng & Min Jour—Jan. 7, 1911. No. 20032.

Silver Prices.

The Course of Silver in 1910. S. Montagu & Co. Reviews the course of prices as dictated by India and China. 3500 w. Eng & Min Jour—Jan. 28, 1911. No. 20643.

Texas.

Shafter Silver District, Presidio County, Texas. William B. Phillips. Describes the geological features, mineral deposits, and milling methods. Ills. 2200 w. Eng & Min Jour—Dec. 31, 1911. No. 19862.

Transvaal.

Mining in the Transvaal in 1910. Hugh F. Marriott. A review of production, metallurgical practice, etc. Also review of Rhodesia. 4500 w. Eng & Min Jour —Jan. 7, 1911. No. 20046.

IRON AND STEEL.

Bessemer Process.

The Constitution of the Slag Formed in the Basic Bessemer Process (Ueber die Konstitution der Thomasschlacke). Hermann Blome. Reports results of an investigation at the Berlin Technical High School. Ills. 2200 w. Stahl u Eisen—Dec. 21, 1910. No. 20448 D.

Blast-Furnace Practice.

Changes in Iron and Steel Making, Bradley Stoughton. Reviews improvements in blast furnace practice and steel processes. 2000 w. Eng & Min Jour—Jan. 7, 1911. No. 20037.

Blast Furnaces.

The Country's New Blast Furnace Construction. B. E. V. Luty. Annual review, showing 13 new stacks completed in 1910—and increase in commercial capacity of about 33,000,000 tons. 2500 w. Ir Trd Rev—Jan. 5, 1911. No. 19946 D.

New Iron and Steel Works Construction. A summary of work completed in 1910, or now under way, reporting 18 blast furnaces building or planned. No new steel capacity projected beyond that announced a year ago. 7500 w. Ir Age —Jan. 5, 1911. No. 19909 D.

Brazil.

Important Development in Brazilian Iron Ores. An account of the large iron-ore deposits, secured by an English company, and the arrangements for their development. Also editorial. Maps. 2700 w. Ir & Coal Trds Rev—Jan. 13, 1911. No. 20522 A.

Electrometallurgy.

The 15-Ton Heroult Furnace at South Chicago. Charles G. Osborne. From a paper read before the Chicago Sec. of the Am. Elec.-Chem. Soc. Illustrates and describes details of the manufacture of electric steel. 2500 w. Ir Age—Jan. 26, 1911. No. 20598.

Electric Smelting of Ore in the United States. J. A. Knesche. Aims to show the economic possibilities in making pig iron in the electric furnaces. Ills. 8500 w. Ir Trd Rev—Jan. 5, 1911. No. 19950 D.

The Direct Reduction of Iron Ore in the Electric Furnace (Notes sur la Réduction directe du Minerai de Fer au Four électrique). G. Arnou. Reviews the process of the Société "La Néo-Métallurgie." Ills. 4300 w. Rev de Métal—Dec., 1910. No. 20410. E + F.

Germany.

Mining Methods in the Minette Mines of the Metz District (Die Abbauverfahren auf den grössern Minettegruben des Kaiserlichen Bergreviers Metz). Herr Lämmert. Describes practice in the more important mines of the district. Ills. 7600 w. Glückauf—Dec. 3, 1910. No. 20452 D.

Metallurgy.

The A B C of Iron and Steel. The first of a series of articles by various authors discussing in semi-technical style, the successive stages of iron and steel manufacture. I. Iron Ore and Mining Operations. John Birkinbine. Ills. Plate. 8000 w. Ir Trd Rev—Jan. 5, 1911. Serial. 1st part. No. 19949 D.

Newfoundland.

The Wabana Mines and Haulage System. Illustrated description of submarine mining of iron ore deposits on the coast of Newfoundland. 1500 w. Qr Bul of Can Min Inst, No. 12—Oct., 1910. No. 20538 N.

Open-Hearth Process.

Open-Hearth Ore Processes in Germany (Die Roheisenerzverfahren in Deutschland). R. Genzmer. Abstract of paper read at the Düsseldorf Congress. A review of all the processes in which ore is added to molten pig in the open-hearth furnace. Ills. 7000 w. Stahl u Eisen—Dec. 21, 1910. No. 20446 D.

Ore Imports.

Record Year for Imports of Foreign Ore. Cas. J. Stark. The iron ore imports to the United States from foreign countries is shown to be the greatest in the history of the industry. 2500 w. Ir Trd Rev—Jan. 5, 1911. No. 19947 D.

Plate Shears.

Electrically-Driven Plate-Shearing Machine. Illustrations with brief description. 300 w. Engng—Jan. 6, 1911. No. 20262 A.

Review of 1910.

The Iron and Steel Industry in 1910. Frederick Hobart. Statistical review, with articles by other authors giving information concerning the mines. 8500 w. Eng & Min Jour—Jan. 7, 1911. No. 20036.

See also Trade, under IRON AND STEEL.

Segregation.

The Influence of Segregation on the Strength of Steel (Der Einfluss der Seigerung auf die Festigkeit des Flusseisens). F. Wüst and H. L. Felser. Read at the Düsseldorf Congress. Reports chemical and mechanical tests on blocks of Bessemer and open-hearth steel. Ills. 3800 w. Stahl u Eisen—Dec. 21, 1910. No. 20447 D.

Spain.

The Bilbao Iron Deposits and Their Importance as Sources of Ore Supply for England and Germany (Die Eisenerzlagerstätten von Bilbao und ihre Bedeutung für die zukünftige Eisenerzversorgung Grossbritanniens und Deutschlands). Herr John. The first part discusses the geology, composition, and extent of the deposits. Ills. 8000 w. Glückauf—Dec. 17 1910. No. 20456 D.

Steel Making.

See Blast-Furnace Practice, under IRON AND STEEL.

Steel Works.

The Works of John Cockerill, Seraing, Belgium. Illustrated detailed description of works employing 11,000 workmen, the methods and equipment. 2500 w. Engr, Lond—Dec. 23, 1910. No. 19978 A.

Steel-Works Ladles.

Modern Steel-Works Ladle Cars and Ladle Cranes (Chariots de Coulée et Grues de Coulée modernes pour Aciéries). C. Michenfelder. A detailed review of modern equipment for handling molten metal. Ills. Serial. 1st part. 6000 w. All Indus—Nov., 1910. No. 20423 D.

Trade.

The Iron and Steel Trade Outlook. T. Good. Reviews from a British viewpoint the possibilities involved in American and British competition. 2500 w. Cassier's Mag—Jan., 1911. No. 20309 B.

The Cincinnati Iron Trade in 1910. Charles L. Smith. Reviews the industry and the influences affecting it. 1800 w. Ir Age—Jan. 5, 1911. No. 19916 D.

The Chicago Iron Trade in 1910. R. L. Ardrey. Review of the iron and steel industry with comparison of prices. 2000 w. Ir Age—Jan. 5, 1911. No. 19915 D.

The Philadelphia Iron Trade in 1910. August A. Miller. A review of production and prices of crude and finished material. 2500 w. Ir Age—Jan. 5, 1911. No. 19914 D.

The Pittsburgh Iron Trade in 1910. Robert A. Walker. Review of a very unsatisfactory year. 3000 w. Ir Age—Jan. 5, 1911. No. 19913 D.

The Sheet and Tin Plate Trades in 1910. B. E. V. Luty. Reviews the production, the market, etc. 1700 w. Ir Age—Jan. 5, 1911. No. 19918 D.

See also same title, under COAL AND COKE.

Tube Mills.

The Republic Iron & Steel Company's New Tube Works. Illustrated detailed description of an important addition to its finishing mills in the Youngstown, Ohio, district. 2000 w. Ir Age—Jan. 5, 1910. No. 19910 D.

LEAD AND ZINC.

Australia.

Zinc Production in Australia. Edward Walker. Information concerning the production and processes, particularly at Broken Hill. Ills. 2000 w. Min & Sci Pr—Jan. 7, 1911. No. 20146.

Lead Smelting.

The Metallurgy of Lead in 1910. H. O. Hofman. A review of practice showing few improvements during the year with the exception of some devices for hastening and cheapening operations. 3500 w. Eng & Min Jour—Jan. 7, 1911. No. 20041.

See also Smelting, under COPPER.

Nevada.

The Yellowpine Mining District of Nevada. Newman B. Gregory. Report of a zinc-lead-silver district first worked by Mormons. 2500 w. Eng & Min Jour—Dec. 31, 1910. No. 19864.

Zinc Mining at Yellow Pine, Nev. Newman B. Gregory. Brief account of the discovery and development of large deposits of zinc carbonate. Ills. 1800 w. Mines & Min—Jan., 1911. No. 19898 C.

Review of 1910.

Refined Lead and Spelter in United States in 1910. Review of imports, exports, consumption and prices. 2000 w. Min Wld—Jan. 21, 1911. No. 20375 C.

The Production of Lead in 1910. Statistics, with an article on the "Southeast Missouri Lead District," by H. A. Wheeler. 4000 w. Eng & Min Jour—Jan. 7, 1911. No. 20034.

The Zinc Industry in 1910. Statistics of production and prices, with articles on the important districts, signed by well-known engineers. 4000 w. Eng & Min Jour—Jan. 7, 1911. No. 20035.

MINOR MINERALS.

Asbestos.

Some Notes on the Origin of Asbestos. A. E. Barlow. Remarks on the origin and formation. Short discussion. 1800 w. Qr Bul of Can Min Inst., No. 12—Oct., 1910. No. 20532 N.

Asbestos, Its Production and Use. H. R. Edgecomb. Information concerning the origin, varieties, characteristics, distribution, production, mining, preparation, uses, etc. Ills. 3000 w. Elec Jour—Jan., 1911. No. 20324.

Cement.

Notes on Portland Cement. D. B. Butler. The present article deals with its manufacture. 3000 w. Aust Min Stand —Dec. 14, 1911. Serial. 1st part. No. 20277 B.

Chromium.

A Study of Electrolytic Chromium (Etude sur le Chrome électrolytique). Jean Voisin. Reviews previous researches, and reports an investigation of the electrolytic production and properties of Chromium. Ills. 5500 w. Rev de Métal —Dec., 1910. No. 20406. E + F.

Cobalt.

The Use of Cobalt Oxide for Making Pigments. J. J. McEachern. Gives results of experiments made in an endeavor to test the possibilities of extending the usefulness of cobalt oxide. 4500 w. Qr. Bul of Can Min Inst, No. 12—Oct., 1910. No. 20536 N.

Nickel.

The Nickel Industry of Canada in 1910. Alex. Gray. Reviews a prosperous year. 3000 w. Min Wld—Jan. 21, 1911. No. 20377 C.

Ocher.

Georgia Ocher Mining and Treatment. W. S. McCallie. Information concerning the deposits and methods of mining and preparing for market. Ills. 700 w. Min Wld—Dec. 31, 1910. No. 19855.

Oil.

Petroleum in the United States. Articles by M. L. Requa, E. Haworth, H. C. George, and R. S. Blatchley, giving information concerning the different oilfields. 5000 w. Eng & Min Jour—Jan. 7, 1911. No. 20047.

The Petroleum Industry in California. Ralph Arnold. A general statement with a review by districts. 2500 w. Min & Sci Pr—Jan. 7, 1911. Serial. 1st part. No. 20159.

Oil Resources of California. M. L. Requa. Map showing the various oilfields developed, with information concerning them. 3500 w. Mining Mag—Jan., 1911. No. 20595 B.

Illinois Oilfields in 1910. Raymond S. Blatchley. Reports production by months, and reviews conditions in the different countries. 1600 w. Min & Sci Pr—Jan. 7, 1911. No. 20160.

The South's Oil Contribution. Dr. David T. Day. Information concerning the production in the Southern States. Also brief review of production in 1910; and a note on natural oil filtration. 4500 w. Mfrs' Rec—Jan. 19, 1911. No. 20290.

Maikop: The Position To-Day. E. de Hautpick. Information concerning this petroleum region. 900 w. Min Jour—Jan. 14, 1911. No. 20504 A.

Phosphate.

Tennessee Phosphate in 1910. John Ruhm, Jr. A review of the industry for the past year, the changes and tendencies. 1400 w. Eng & Min Jour—Jan. 14, 1911. No. 20187.

Platinum.

See Review of 1910, under Gold and Silver.

Precious Stones.

Gem Mining in California a Profitable Industry. A. H. Martin. Information concerning the tourmaline and turquois deposits. 1500 w. Min Wld—Dec. 31, 1910. No. 19856.

Sodium.

Deposits of Sodium Salts in Wyoming. Alfred R. Schultz. Abstracted from Mineral Resources of the U. S. Map and brief description. 1200 w. Min Wld—Dec. 31, 1910. No. 19858.

Tin.

The Northern Dundas Tin District. J. M. Bell. Information concerning those tinfields of Tasmania. 1500 w. Mining Mag—Jan., 1911. No. 20507 B.

Tin Quartz Mining and Smelting in Texas. Charles A. Dinsmore. An illustrated account of a deposit near El Paso, Tex., and its recent development. 2000 w. Min Wld—Dec. 31, 1910. No. 19857.

MINING.

Accidents.

Mining Accidents. Day Allen Willey. Experimental investigations of safety appliances are illustrated and described. 2000 w. Cassier's Mag—Jan., 1911. No. 20306 B.

Boring.

A B C of Empire Drilling. J. P. Hutchins and N. C. Stines. An illustrated article giving details essential to the efficient manipulation of a particular type of drill as used in sampling alluvial ground, with other information. 3500 w. Min & Sci Pr—Jan. 7, 1911. Serial. 1st part. No. 20152.

Costs.

Graphic Calculations of Development Work Costs. Claude T. Rice. Gives contract diagrams, with explanation of their use. 600 w. Eng & Min Jour—Jan. 21, 1911. Serial. 1st part. No. 20360.

Development.

Preliminary Development Work. Alan M. Bateman. Gives facts derived from personal experience. Ills. 2500 w. Qr Bul of Can Min Inst, No. 12—Oct., 1910. No. 20537 N.

See also Costs, under Mining.

Drainage.

See Mine Drainage, under Coal and Coke.

Drills.

A Comparison of Electric and Gasoline Driven Blast-Hole Drills. B. G. Cope. Discusses the kind of power most suitable for operating blast-hole drills of the well driller type in quarry work. 1200 w. Eng News—Dec. 29, 1910. No. 19798.

Automatic Drill Advancing Devices (Selbstätige Vorschubvorrichtungen für Bohrhämmer). Herr Cabolet. Describes the devices incorporated in a number of European drills. Ills. 8500 w. Glückauf—Dec. 10, 1910. No. 20454 D.

Explosives.

The Works of the British Explosives Syndicate, Limited, Pitsea, Essex. Illustrated, detailed description of the methods of manufacture of the explosives made. 5000 w. Col Guard—Jan. 13. 1911. No. 20509 A.

The Use of Chlorates in Commercial Explosives. A. L. Jones. An interesting review of past and present experience with explosives using chlorates. 2000 w. Eng News—Jan. 5, 1911. No. 19934.

Notes on Explosives (Ueber Sprengmittel). W. Will. The first part reviews the history of explosives. Serial. 1st part. 4200 w. Zeitschr d Oest Ing u Arch Ver—Dec 16, 1910. No. 20481 D.

Graphic Records.

A Graphical Note-Book. F. W. Gray. Explains a graphic method of recording data in connection with mining work. 2000 w. Mines & Min—Jan., 1911. No. 19896 C.

Haulage.

Installation, Operation, and Supervision of Mine Railways (Anlage, Inbetriebsetzung und Beaufsichtigung der dem Bergwerksbetriebe dienenden Bahnen). The text of regulations recently issued by the Mine Inspector, Breslau, Germany. 7000 w. Glückauf—Dec. 3, 1910. No. 20453 D.

See also Newfoundland, under Iron and Steel.

Hoisting Cages.

Improvements in Hoisting Cages. James J. Smith. Gives details of simple arrangements which will lessen accidents. 3500 w. Eng & Min Jour—Jan. 21, 1911. No. 20357.

Laws.

Mining Laws of Burma. C. Dawes Clark. Deals principally with the rules governing metal mining, and how they work in practice. 2500 w. Min & Sci Pr—Jan. 14, 1911. No. 20292.

Mine Cars.

Tub Couplings Used in German Collieries. O. Schulz, in *Glückauf*. Illustrates and describes improved types introduced. 1500 w. Col Guard—Dec. 23, 1910. No. 19969 A.

Mine Locomotives.

Two-Stage Air Locomotives. Discusses the increased economy of two-stage compared with single-stage compressed air locomotives. Ills. 5500 w. Mines & Min—Jan., 1911. No. 19899 C.

Photography.

Photography for Mining Engineers and Geologists. H. Mortimer Lamb. Suggestions as to practical methods of working, when in the field, to secure satisfactory results. 2500 w. Qr Bul of Can Min Inst, No. 12—Oct., 1910. No. 20531 N.

Prospecting.

See same title, under Coal and Coke.

Pumping.

The Old Dominion Pumping System. R. S. Herrick. Illustrates and describes the equipment of pumps, arrangement of sump, etc., in the new plant. 2000 w. Mines & Min—Jan., 1911. No. 19895 C.

Shaft Sinking.

Recent Developments in the Freezing Process (Das Gefrierverfahren und seine neueste Entwicklung). Herr Zaeringer. Describes the practice of Gebhardt & König in Austria. Ills. Serial. 1st part. 2300 w. Oest Zeitschr f Berg u Hüttenwesen—Dec. 17, 1910. No. 20451 D.

Shaft Stations.

Proposed Layout for a Shaft Bottom. Plan and description. 500 w. Eng & Min Jour—Jan. 21, 1911. No. 20362.

Stoping.

The Shrinkage Method of Stoping at the Ferreira Gold Mine. G. Heldick Smith. Considers "shrinkage" and "back filling" methods of overhand stoping as practiced in various parts of the world, describing the method as applied at the mines named, and discussing the advantages, disadvantages, etc. Ills. 5000 w. Jour Chem, Met & Min Soc of S Africa—Nov., 1910. No. 20240 E.

Surveying.

On Methods of Making Large Scale Contour Surface Plans of Claims or Mining Properties. W. H. Boyd. Suggests methods that can be employed at a comparatively small cost with sufficiently accurate results. Ills. 3000 w. Qr Bul of Can Min Inst, No. 12—Oct., 1910. No. 20530 N.

ORE DRESSING AND CONCENTRATION.

Classifiers.

Development of Hindered Settling Apparatus. Robert H. Richards. Reviews the steps taken in the development, the facts obtained, and some of the conclusions as to the effect of it in improving concentrating methods and machinery. Ills. 10500 w. Qr Bul of Can Min Inst, No. 12—Oct., 1910. No. 20528 N.

Drying.

New Methods and Apparatus for Coal Drying (Neuere Verfahren und Einrichtungen auf dem Gebiete der Kohletrocknung). Herr Jordan. Describes types of revolving and stationary drum dryers. Ills. 3000 w. Glückauf—Dec. 10, 1910. No. 20455 D.

Filters.

New Slime Filter at El Oro, Mex. Edwin Burt. Illustrated description of a horilontal tubular filter operating under pressure from gravity. 1600 w. Eng & Min Jour—Jan. 21, 1911. No. 20358.

Gold Milling.

Progress in Treatment of Gold and Silver Ores During 1910. Alfred James. A review of progress in the various gold mining countries, the new methods introduced, and related subjects of interest. Ills. 4000 w. Min & Sci Pr—Jan. 7, 1911. No. 20155.

Stamp Milling in 1910. Louis D. Huntoon. Reviews practice in the United States and South Africa. 2000 w. Eng & Min Jour—Jan. 7, 1911. No. 20040.

Iron Ores.

Washing the Sandy Ores of the Western Mesabi. E K. Soper. Illustrated description of a concentration plant which makes possible the utilization of the inferior ores of the Minnesota ranges. 3000 w. Ir Trd Rev—Jan. 19, 1911. No. 20291.

Review of 1910.

Progress in Ore Dressing in United States and Mexico During 1910. H. A. Guess. Reviews progress in water concentration, cyaniding, etc. 2200 w. Met & Chem Engng—Jan., 1911. No. 20129 C.

Silver Milling.

See Gold Milling, under Ore Dressing and Concentration.

Slimes Treatment.

Mechanical and Air Agitation for Slime Treatment. A. W. Warwick. Comments on the defects of the Pachuca tank. 2000 w. Min Wld—Jan., 1911. No. 20664.

MISCELLANY.

Alaska.

Mineral Resources Southern Kenai Peninsula. U. S. Grant and D. F. Higgins. Abstract from Bul. 442, U. S. Geol. Surv. Maps and information concerning deposits of iron, gold, silver, antimony, and coal. 4500 w. Min Wld—Jan. 14, 1911. No. 20210.

British Columbia.

British Columbia. E. Jacobs. A review of the mining industry. 3000 w. Can Min Jour—Jan. 1, 1911. No. 19893.

Metallury in British Columbia in 1910. E. Jacobs. Reviews progress in the smelting of lead and copper ores, and related matters. 5500 w. Met & Chem Engng—Jan., 1911. No. 20127 C.

The Mineral Resources of a Part of the Yale District, B. C.—A Descriptive Summary. Charles Camsell. Considers the general and economic geology of this region. 5500 w. Qr Bul of Can Min Inst—Oct., 1910. No. 20533 N.

Canada.

The Production of Cement, Lime, Clay Products, Stone, and Other Structural Materials in Canada During the Calendar Year 1909. John McLeish. Advance chapter of the Annual Report on the mineral production. 11000 w. Can Dept of Mines, No. 85. No. 20313 N.

I. Ontario Mineral Production in 1910. Thomas W. Gibson. II. Mining in British Columbia in 1910. E. Jacobs. Reviews of the metals in order. 2800 w. Eng. & Min Jour—Jan. 7, 1911. No. 20045.

China.

The Far East. Thomas T. Read. A review of mining conditions and the effect of international politics on the industry. 2500 w. Min & Sci Pr—Jan. 7, 1911. No. 20158.

Colorado.

The Status of Meallurgy in Colorado in 1910. A review of progress in smelting, chlorination, cyaniding, ore dressing, etc. 3500 w. Met & Chem Engng—Jan., 1911. 20126 C.

Colorado Mineral Production. Theo. F. Van Wagenen. Gives an analysis of the mining situation, discussing the decline in output, and the causes. 1500 w. Min & Sci Pr—Jan. 7, 1911. No. 20148.

Utilization of Colorado Minerals. Franklin Ginterman. Excerpts from a paper on "The Use, Non-use and Waste of the Mineral Resources of Colorado." Read before the Colo. Sci. Soc. 4000 w. Eng & Min Jour—Jan. 21, 1911. No. 20359.

Costa Rica.

Costa Rica Mineral Resources. Lee Fraser. Reviews the history and gives information of conditions and of the known occurrences of minerals. Ills. 2000 w. Min & Sci Pr—Jan. 21, 1911. No. 20627.

Japan.

Mineral Resources of the Japanese Empire. Dr. A. Selwyn-Brown. An illustrated review of coal, iron, petroleum and minor metals. 4000 w. Engineering Magazine—Jan., 1911. No. 19746 B.

London Market.

London Mining Market. T. A. Rickard. Reviews the year 1910, giving information concerning various mining products and the mining conditions in different parts of the world. 3800 w. Min & Sci Pr—Jan. 7, 1911. No. 20145.

Metal Markets.

Metal Reviews. Brief reviews by different authors of the market for copper, spelter and zinc ore, lead and silver during 1910. 2000 w. Min & Sci Pr—Jan. 7, 1911. No. 20144.

Mexico.

Mining in Mexico in 1910. Kirby Thomas. A review of the mining industry for the year, each district being reported by writer of authority. 10800 w. Eng & Min Jour—Jan. 7, 1911. No. 20043.

General Conditions in Mexico. Theo. F. Van Wagenen. Deals with racial characteristics, the geographical, topographical and climatic features, agricultural and mineral products, and the effect of other civilizations. Ills. 4000 w. Mining Mag—Dec., 1910. No. 19737 B.

South of the Rio Grande River, Mexico. Walter M. Brodie. Illustrated description of the country and its mineral wealth. Map. 2200 w. Min Wld—Dec. 10, 1910. No. 19282.

Mining Frauds.

Protecting Investors by Exposing Mining Frauds. C. S. Thomas, Jr. Discusses the need of legislation and publicity to supplement the work of postal authorities. 4000 w. Eng & Min Jour—Dec. 10, 1910. No. 19260.

Nevada.

Metallurgical Progress in Utah and Nevada During 1910. Robert H. Bradford. A general review. 6000 w. Met & Chem Engng—Jan., 1911. No. 20134 C.

Nicaragua.

Mining in Nicaragua. T. Lane Carter. Sketch map showing the location of mining districts, brief review of their history, mining laws, transportation facilities, health conditions, etc., showing the difficulties and advantages. Ills. 12500 w. Bul Am Inst of Min Engrs—Dec., 1910. No. 19715 F.

Ontario.

Ontario in 1910. T. W. Gibson. A review of the mining industry. 2000 w. Can Min Jour—Jan. 1, 1911. No. 19892.

Ore Deposits.

Origin of Gold "Pockets" in Northern California. Oscar H. Hershey. A study of the pocket deposits with the writer's past and present views in regard to their origin. 1700 w. Min & Sci Pr—Dec. 3, 1910. No. 19254.

Secondary Enrichment in the Copper Deposits of Huelva, Spain. A. Moncrieff Finlayson. Gives results of investigations made in the summer of 1909, by microscopic methods. 5000 w. Inst of Min & Met. Bul. No. 74—Nov. 9, 1910. No. 19763 N.

Discussion on "Secondary Enrichment in the Copper Deposits of Huelva, Spain." Critical discussion of conclusions drawn by A. Moncrieff Finlayson in his paper on this subject. 6500 w. Inst of Min & Met, Bul. No. 75—Dec. 14, 1910. No. 19768 N.

Anthracite in a Fissure Lode. Lionel C. Ball. Read before the Roy. Soc. of Queensland. Brief record of an occurrence of coal as gangue in a lead-zinc fissure lode. 500 w. Queens Gov Min Jour—Dec. 15, 1910. No. 20242 B.

The Laws of Intrusion. Blamey Stevens. Aims to show how igneous intrusion is governed by definite mathematical laws, and that the main factor is the system of stress to which the rocks are subject. Ills. 6500 w. Bul Am Inst of Min Engrs—Jan., 1911. No. 20580 F.

The Genesis of Asiatic Mineral Deposits (La Métallogénie du Continent Asiatique). L. De Launay. Develops the author's theory of metallogenetic provinces as applied to Asia. 5000 w. Rev Gen d Sci—Dec. 15, 1910. No. 20416 D.

Quebec.

The Mining Industry in the Province of Quebec During 1910. Theo. Denis. A review of the past year. 2000 w. Can Min Jour—Jan. 1, 1911. No. 19891.

Review of 1910.

The Non-Ferrous Metal Markets in 1910. J. Chalmers Warwick. Review of the copper, tin, lead and spelter markets, with estimates of production and price fluctuations. 2500 w. Ir Trd Rev—Jan. 5, 1911. No. 19952 D.

South America.

Mining in South America in 1910. A general review, and also a review of Chile, by H. K. Masters. 4000 w. Eng & Min Jour—Jan. 7, 1911. No. 20044.

Sweden.

Swedish Mines and Mining. Horace V. Winchell. Interesting review of the important mining districts. 3500 w. Min & Sci Pr—Jan. 7, 1911. No. 20151.

United States.

Mining in the United States. A review by states of the mining industry during 1910, by leaders in their various fields. Map. 17000 w. Eng & Min Jour—Jan. 7, 1911. No. 20042.

RAILWAY ENGINEERING

CONDUCTING TRANSPORTATION.

Collisions.

A Disastrous Collision on the Midland Railway of England. H. Raynar Wilson. An explanation of the cause of the accident occurring on Dec. 24, 1910. 1200 w. Eng News—Jan. 26, 1911. No. 20619.

Signaling.

Third Annual Report of the Block-Signal and Train-Control Board to the Interstate Commerce Commission. (Slightly condensed.) 9000 w. Eng News—Jan. 19, 1911. No. 20289.

Third Annual Report of Block-Signal and Train-Control Board. Brief review of the work of the Board, and of the devices examined. 4500 w. Ry Age Gaz —Jan. 20, 1911. Serial. 1st part. No. 20350.

The "Run-Through Signal." Dr. Hans A. Martens. A critical discussion of this signal as used. 3800 w. Bul Int Ry Cong—Jan., 1911. No. 20594 G.

The Route Lever in Mechanical and Power Switch Frames. Mr. Pfeil. Also note by Mr. Kraft, and reply. 2700 w. Bul Int Ry Cong—Jan., 1911. No. 20593 G.

MOTIVE POWER AND EQUIPMENT.

Air Brakes.

Presidential Address. George Westinghouse. An account of the conception and development of the air-brake. Ills. 6000 w. Jour Am Soc of Mech Engrs—Jan., 1911. No. 20570 F.

No. 6 Distributing Valve Test Rack. Illustrated description of a test rack for use in connection with the cleaning and repairing of distributing valves. 2500 w. Ry & Loc Engng—Jan., 1911. No. 20017 C.

Car Cleaning.

Cleaning Passenger Equipment at Terminals. J. H. Pitard. Suggestions for the proper care of equipment, especially the cleaning compounds used. 1200 w. Ry Age Gaz—Jan. 6, 1911. No. 20028.

Electrification.

The Electrification Problem on Trunk Line Railways. A. D. Williams. Considers the problems that must be solved before any general revolution in methods of operation can occur. 1800 w. Engineering Magazine — Feb., 1911. No. 20683 B.

The Electrical Equipment of the Detroit River Tunnel. Remarks on improvement of railroad facilities at Detroit, Mich., with illustrated description of the electrical scheme. 3000 w. Elec Ry Jour—Jan. 14, 1911. Serial. 1st part. No. 20161.

Locomotive Boilers.

Improved Boiler Washing Apparatus. Illustrates and describes the National Boiler Washing equipment. 1200 w. Ry & Loc Engng—Jan., 1911. No. 20020 C.

Locomotive Efficiency.

The Efficiency of the Steam Locomotive (Der Wirkungsgrad der Dampflokomotive). Dr. Sanzin. Reports tests made by the author under various conditions. 8100 w. Zeitschr d Oest Ing u Arch Ver —Dec. 2, 1910. No. 20479 D.

Locomotive Maintenance.

Standard Locomotive Maintenance Practices. Gives returns from several railways indicating the importance of standardization in defining limits of wear. Also editorial. 2700 w. Am Engr & R R Jour—Jan.. 1911. No. 19930 C.

Locomotive Operation.

Notes on the Economics of Locomotive Operation. Arthur J. Wood. Considers lines of progress leading to better economy and higher efficiency. 4000 w. Stevens' Ind—Jan., 1911. No. 20315 D.

Locomotive Performance.

Performance of Four-Cylinder Balanced Simple Locomotive on the C., R. I. & P. Ry. An account of the behavior of engines in service more than a year, with data concerning special tests. 1500 w. Ry & Engng Rev—Jan. 21, 1911. No. 20384.

Locomotives.

Locomotives. Reviews the British Locomotives of 1910. Ills. 2500 w. Engr, Lond—Jan. 6, 1911. No. 20271 A.

High Speed Locomotives. A review of the development in various countries for runs scheduled at over sixty miles an hour. 6500 w. Am Engr & R R Jour—Jan., 1911. No. 19932 C.

4-8-0 Type Locomotives for the Norfolk & Western Railway. Powerful locomotives, known as class M-2, are illustrated and described. 1200 w. Am. Engr & R R Jour—Jan., 1911. No. 19929 C.

Four-Cylinder Balanced Simple Locomotives, Chicago, Rock Island and Pacific. Abstract of Bul. No. 1007. Am. Loc. Co., N. Y. Describes these engines, reporting service tests, and illustrates the design and details. 2500 w. Ry Age Gaz—Jan. 6, 1911. No. 20029.

Mikado Locomotive for Burning Lignite; Oregon Railroad and Navigation Company. Illustrated description of an engine specially built to burn lignite, with report of tests. 1000 w. Ry Age Gaz—Jan. 27, 1911. No. 20637.

4-4-0 Engine for the Western Railroad of Havana. Illustrated description of an 8-wheel passenger locomotive. 800 w. Ry & Loc Engng—Jan., 1911. No. 20018 C.

Locomotive Spark Arresters.

Notes of Experiments Upon Locomotive Spark-Arresters. Thomas Thompson. Read before the Students' Soc. of the Inst. of Engrs. & Shipbldrs. in Scotland. An illustrated report of experiments made by the Caledonian Ry Co. in Jan., 1909. 2500 w. Mech Engr—Dec. 30, 1910. No. 20085 A.

Locomotive Superheating.

The Effect of High Temperatures on Locomotive Cylinders and Valves. Editorial discussion of effects of superheating, giving testimony from a number of sources. 1500 w. Ry Age Gaz—Jan. 20, 1911. No. 20349.

Feed-Water Heating and Superheating on the Egyptian State Railways. Drawings and brief account of the Trevithick combined system of feed-water heating and superheating. 700 w. Engr, Lond—Jan. 13, 1911. No. 20520 A.

Locomotive Tests.

Tests of "E2a" Atlantic Type, Simple Locomotive. Gives results of a series of tests made at the testing plant at Altoona, Penna., describing the locomotive, and giving illustrations, diagrams, tables, etc. 8500 w. Penn R R Co, Bul No. 5. No. 20310 N.

Locomotive Valve Gears.

The Pilliod Locomotive Valve Gear. Illustrated detailed description of an ingenious mechanism for imparting valve motion through crosshead connection, without either eccentric or return crank. 1000 w. Am Engr & R R Jour—Jan., 1911. No. 19931 C.

Passenger Cars.

Luxurious Private Car for South America. Illustrations and brief description of a car for the President of the Argentine Republic. 500 w. Sci Am—Jan. 7, 1911. No. 19942.

Composite Steel Passenger Equipment. Illustrates and describes an interesting design wherein the framing and exterior sheathing are of steel and the interior finishing from the sash rest up is of wood. 2500 w. Am Engr & R R Jour—Jan., 1911. No. 19928 C.

Shops.

Railroad Repair Shop Efficiency. Max H. C. Brombacher. Tabulated information requested by the Interstate Commerce Commission, with analysis of the contents of the tabulation, showing great variations in the shop costs of different companies. 3000 w. Ir Age—Jan. 5, 1911. No. 19908 D.

Increasing Shop Output. Gives prize papers on this subject by H. L. Burrhus, C. E. Stone, Charles Maier, and J. F. Perritt. 4000 w. Ry Age Gaz—Jan. 6. 1911. No. 20026.

Care and Selection of Shop Equipment. Articles by W. P. Spade, John V. Le Compte, W. H. Snyder, John M. Hamm, William G. Reyer, and others. 5500 w. Ry Age Gaz—Jan. 6, 1911. No. 20030.

Micrometer Boring Bar for Car Wheels. R. R. Wan. Illustrates and describes a boring bar with improved micrometer attachment, explaining its advantages. 1500 w. Am Mech—Jan. 26, 1911. No. 20606.

Car Repair Kinks. Illustrated prize papers by W. H. Snyder and C. C. Leech, F. Rattek and A. G. Pancost. 2500 w. Ry Age Gaz—Jan. 6, 1911. No. 20024.

The Central of Georgia Railway Boiler Shop. Sections and details of framing of shop at Macon, Ga. 1200 w. Eng Rec—Jan. 21, 1911. No. 20341.

The Locomotive Repair Shops of the Burlington at Havelock, Neb. Illustrated detailed description of reconstructed and additional shops and new power plant. Plate. 2500 w. Ry Age Gaz—Jan. 6, 1911. No. 20027.

Shops of the Chicago, Burlington & Quincy R. R. at Havelock, Neb. Illustrated detailed description of the extensive additions to the equipment at the plant near Lincoln, Neb. 2500 w. Ry & Engng Rev—Dec. 31, 1910. No. 19876.

Supply Department.

The Supply Department. H. C. Pearce. A study of the losses due to lack of organization and intelligent watchfulness. 3000 w. Ry Age Gaz—Jan. 6, 1911. Serial. 1st part. No. 20021.

Train Resistance.

Freight Train Resistance—Its Relation to Car Weight. Edward C. Schmidt. A report of tests, methods and means of conducting them, with discussion of results. 20000 w. Bul Univ of Ill—May 30, 1910. No. 20669 N.

NEW PROJECTS.

Africa.

The Benguella Railway. Map and information concerning a new line in Portuguese Angola, South-West Africa. 500 w. Engr, Lond—Dec. 23, 1910. No. 19981 A.

D., L. & W. R. R.

New Cut-Off Line, D., L. & W. R. R. Illustrates and describes the construction of the line between Slateford, Pa., and Hopatcong, N. J. 1600 w. Ry & Engng Rev—Jan. 28, 1911. No. 20662.

Switzerland.

The Furka Railway (Les Chemins de Fer de la Furka). Brief description of the Brigue-Gletsch-Disentis line about to be constructed. Ills. 2000 w. Bul Tech d l Suisse Romande—Dec. 25, 1910. No. 20422 D.

Western Maryland.

The Western Maryland Extension to Connellsville, Penn. Map and illustrated description of the new line from Cumberland, Md., to Connellsville, a distance of 87 miles. 3000 w. Eng Rec—Dec. 31, 1910. No. 19873.

The Cumberland-Connellsville Extension of the Western Maryland Ry. Map and description of 87 miles of construction work. 1000 w. Eng News—Jan. 26. 1911. No. 20621.

PERMANENT WAY AND BUILDINGS.

Construction.

See Excavation, under CIVIL ENGINEERING, CONSTRUCTION.

Crossings.

Notes on the Design and Construction of Railroad Crossings. Illustrations, with discussion of types of crossings and details of construction. 3300 w. Engng Con—Jan. 25, 1911. No. 20614.

Railway Grade Crossing Elimination in Cleveland. Robert Hoffmann. Explains the general conditions, reviewing the history of grade separation, and illustrating and describing construction work. Discussion. 8500 w. Jour Cleveland Engng Soc—Dec., 1910. No. 20328 D.

Curves.

New Methods of Laying Out Curves (Méthodes nouvelles pour l'Etude des Tracés de Voies). P. Le Fort. An exhaustive discussion of methods developed by the author. Ills. Serial. 1st part. 22000 w. Rev Gen d Chemins d Fer—Dec., 1910. No. 20411 G.

Explosions.

The Disastrous Explosion at the Grand Central Terminal. Illustrated description of the results of the explosion. 800 w. Sci Am—Dec. 31, 1910. No. 19787.

Narrow Gauge.

A Remarkable American Forest Railway. A. Reiche. Illustrates and describes a profitable narrow-gauge industrial road in Michoacan, Mexico. 1200 w. Sci Am Sup—Jan. 28, 1911. No. 20639.

Rails.

Rail Trimming Mill and Material Yard, C., M. & St. P. Ry. Illustrates and describes a mill for trimming or "cropping" the ends of worn rails, and a yard for stock piles of trimmed and rerolled rails, joints, splices and tie plates, located at Savanna, Ill. 2500 w. Ry & Engng Rev—Jan. 14, 1911. No. 20211.

Snow Sheds.

Snow Sheds on the Great Northern. Illustrates and describes a reinforced-concrete shed at Wellington, Wash. 1000 w. Ry Age Gaz—Jan. 13, 1911. No. 20165.

Terminals.

Railway Passenger and Freight Terminals in Large Cities. Frederic A. Delano. From a paper in the Chicago "Tribune" of Dec. 14. Suggestions for solving the problem in Chicago. with a general analysis of railway terminal facilities. 1500 w. Eng News—Jan. 5, 1911. No. 19941.

Union Terminals of Canadian Northern Railway and Grand Trunk Pacific Railway at Winnipeg, Manitoba. C. D. Archibald. Describes the passenger and freight terminals. Ills. 2500 w. Can Engr—Jan. 19, 1911. No. 20381.

Tie Plates.

New Tie Plates of the Pittsburgh & Lake Erie R. R. Illustrated description of two forms adopted, one for ordinary track, the other on bridges. 1200 w. Eng News—Jan. 26, 1911. No. 20622.

Ties.

Railway Cross-Tie Records. From a paper by F. J. Angier. On the unreliability of the records with suggestions for keeping a service record. 3500 w. Eng Rec—Jan. 28, 1911. No. 20654.

Track Laying.

Cost of Track Laying. H. C. Landon. A report of cost and progress of track laying by the old methods. 700 w. Ry Age Gaz—Jan. 13, 1911. No. 20163.

Train Sheds.

Bush Train Shed at Baltimore. Illustrated description of a Bush train shed installed over depressed tracks. 700 w. Ry Age Gaz—Jan. 13, 1911. No. 20162.

Yards.

The Design and Operation of a Modern Classification Yard. W. A. MacCart. An outline of hump methods used in a yard. Ills. Also discussion. 4000 w. Pro Engrs' Club of Phila—Jan., 1911. No. 20579 D.

TRAFFIC.

Damage Liability.

The Initial Carrier's Liability. Abstract of opinion of the U. S. Supreme Court in holding the initial carrier liable for damages occurring off its own lines. 3000 w. Ry Age Gaz—Jan. 13 1911. No. 20164.

Freight Rates.

The Rate Advance Investigation. A Composite Brief. Willard A. Smith. Presents the points on which the writer believes the case must be decided. 4000 w. Ry & Engng Rev—Jan. 28, 1911. No. 20663.

Studies in Railway Economics. W. M. Acworth. A discussion of the principles governing railway rate making. 2000 w. Ry Age Gaz—Jan. 6, 1911. Serial. 1st part. No. 20023.

MISCELLANY.

Canada.

Prosperity of Canadian Railways. J. L. Payne. An interesting account of growth and general prosperity during 1910. 3000 w. Ry Age Gaz—Jan. 6, 1911. No. 20022.

Capitalization.

Two Studies of Railway Capitalization. Editorial discussion of certain points brought out in articles by Frank Trumbull, and by W. H. Williams. 2000 w. Ry Age Gaz—Feb. 3, 1911. No. 20798.

Economics.

The Re-working of Old Material. Jas. S. Sheafe. An illustrated account of the economies and saving effected by the methods of the Illinois Central Railroad. Discussion. 11000 w. Pro W Ry Club—Dec. 20, 1910. No. 20546 C.

International Congress.

The XXVth Anniversary of the Foundation of the International Railway Congress Association. L. Weissenbruch. Reviews the history from 1885 to 1910. 66700 w. Bul Int Ry Cong—Jan., 1911. No. 20592 G.

Official Information Issued by the Permanent Commission of the International Railway Congress Association. Summary of proceedings of the eighth session, at Berne, 1910. 73000 w. Bul Int Ry Cong —Dec., 1910. No. 20547 G.

Report of the Interstate Commerce Commission. Abstract of the report on the work of the commission. 4000 w. Ry Age Gaz—Dec. 30, 1910. Serial. 1st part. No. 19847.

Proceedings of the Eighth Session of the International Railway Congress, Berne. July, 1910 (Compte rendu sommaire des Séances de la 8e Session du Congrès International des Chemins de Fer). Summarizes the action of the Congress on the various questions submitted. 14500 w. Rev Gen d Chemins d Fer—Dec., 1910. No. 20412 G.

Italy.

The Railways of Liguria and Piedmont (La Rete ferroviaria Ligure-Piemontese). Describes transportation facilities in this part of Italy. Serial. 1st part. 2000 w. Ing Ferro—Dec. 1, 1910. No. 20443 D.

Malay States.

The Federated Malay States Railways. Information concerning the proposed extensions of the system and the financial conditions. Map and Ills. 1200 w. Far East Rev—Dec., 1910. No. 20888 N.

Management.

The Mistakes of Efficiency Men. This first article of a series discusses the extravagant statements and claims made in regard to railway management—Also editorial. 3200 w. Ry Age Gaz—Jan. 6, 1911. Serial. 1st part. No. 20025.

United States.

Review of 1910 Annual Reports. Diagrams showing results of railway operation with explanatory notes. Also editorial. 6000 w. Ry Age Gaz—Dec. 30, 1910. No. 19846.

Valuation.

Physical Valuation and Capitalization. A statement by Prof. Frank Haigh Dixon, which refutes a statement made by Clifford Thorne, to the effect that railways in the states where valuations have been made are over-capitalized. 4000 w. Ry Age Gaz—Jan. 20, 1911. No. 20351.

STREET AND ELECTRIC RAILWAYS

STREET AND ELECTRIC RAILWAYS.

Boston.

Twelve Years' Development of Rapid Transit in Boston: The Extensions and Additions of the Boston Elevated Railway Co. Map and outline of developments since 1898. 1500 w. Eng News—Jan. 26, 1911. No. 20618.

Cars.

New Rolling Stock for the District Railway. Gives exterior and interior views of the new steel cars, with drawings and description. 700 w. Engr, Lond Jan. 13, 1911. No. 20521 A.

Controllers.

The Thomson-Houston-Sprague System of Multiple-Unit Control (Equipement à Unités Multiples. Systéme Thomson-Houston-Sprague). J. A. Montpelier. A detailed analysis of the system of connections. Ills. 2000 w. L'Elecn—Dec. 3, 1910. No. 20418 D.

Depreciation.

A Discussion of the Depreciation Problem, with Particular Reference to Electric Railways. William B. Jackson. 5000 w. Engng-Con—Feb. 8, 1911. No. 20902.

Electric Traction.

Jarman's System of Electric Traction. Historical account of a storage battery system that was proved practical in 1886. 1000 w. Sci Am Sup—Jan. 14, 1911. No. 20175.

The Economy of Proper Working Weights in Electric Traction (Wirtschaftliche Betriebsgewichte und überraschende Ersparnisse durch ihre Anwendung bei Zugkraftanlagen). Herr Beyer. Discusses this subject with special reference to street railways. 2300 w. Elek Kraft u Bahnen—Dec. 4, 1910. No. 20493 D.

Franchises.

See Subways, under STREET AND ELECTRIC RAILWAYS.

Interurban.

The Washington, Baltimore & Annapolis Electric Railway. Illustrated description of a 1200-volt d. c. system on a high-speed interurban line. 3000 w. Ry & Engng Rev—Jan. 21, 1911. No. 20383.

Locomotives.

2000 H. P. 15000-Volt Single-Phase Locomotive. Illustrated description of this machine. 1700 w. Elect'n, Lond—Jan. 6, 1911. No. 20248 A.

New York.

The Report of the Citizens' Committee on the New York Rapid Transit Problem. Extracts from the Committee's report, and also from the reports of its subcommittees on Finance and on Engineering. 5000 w. Eng News—Jan. 12, 1911. No. 20141.

Paris.

See Subways, under STREET AND ELECTRIC RAILWAYS.

Pittsburg.

City Transportation Problems: A Report by Bion J. Arnold on the Pittsburg Situation. General discussions are given in the present number. 6000 w. Eng News—Feb. 9, 1911. Serial. 1st part. No. 20919.

Power Economy.

Units per Car Mile. W. Capone. A study of the most economical method of handling cars, the effect of installing meters on cars, etc. 3000 w. Tram & Ry Wld—Jan. 5, 1911 No. 20396 B.

Rack Railways.

The Electrification of the Corcovado Rack Railway, Near Rio de Janeiro (L'Electrification du Chemin de Fer à Crémaillère du Mont Corcovado, près Rio de Janeiro). Georges Zindel. Describes the new rolling stock recently installed. Ills. 2500 w. Génie Civil—Dec. 24, 1910. No. 20431 D.

Rail Corrugation.

Corrugation of Rails. J. H. Briggs. Describes experiments showing that the climbing action of the wheel on the rail permits periodic movements. 4500 w. Elect'n, Lond—Jan. 13, 1911. No. 20502 A.

Rates.

The Adjustment of American Street Railway Rates to the Expansion of City Areas. George H. Davis. A statement of conditions and a discussion of fare limits. 2500 w. Elec Ry Jour—Feb. 4, 1911. No. 20806.

Single Phase.

The Lyons-Jons and Lyons-Miribel High-Tension Single-Phase Tramways (Les Tramways à Courant monophasé haute Tension de Lyon à Jons et à Miribel). O. Lombard-Gerin. Brief description of the line equipment and rolling stock. Ills. 3000 w. Génie Civil—Dec. 3, 1910. No. 20424 D.

Subways.

The Paris Subway System—With Special Reference to Franchise Terms and Conditions. Robert H. Whitten. Detailed account of the method in Paris of dealing with the subway problems. Map. 9800 w. Eng News—Jan. 19, 1911. No. 20287.

The Paris Nord-Sud Underground Electric Railway (Le Chemin de Fer électrique souterrain Nord-Sud de Paris). A. Dumas. A comprehensive review of the engineering features, with map. Ills. 9500 w. Génie Civil—Dec. 10, 1910. No. 20426 D.

Switzerland.

The Lugans-Tesserete Electric Railway (Die elektrische Bahn Lugano-Tesserete). Brief description of this 1000-volt direct current line. Ills. Serial. 1st part. 1600 w. Schweiz Bau—Dec. 10, 1910. No. 20463 B.

Transfer Tables.

Flush Transfer Table in Kansas City Railway Shops. Illustrations, drawings and description of interesting details. 500 w. Elec Ry Jour—Jan. 28, 1911. No. 20658.

Trolley Maintenance.

Inspection and Maintenance of Overhead Lines. M. Otto. Summary of information from 110 replies to questions sent out, showing diversity in practice. Ills. 12000 w. Tram & Ry Wld—Jan. 5, 1911. No. 20397 B.

Valuation.

A Logical Basis for Valuations of Interurban Street Railways. C. G. Young. From a paper read before the Cent. Elec. Ry. Assn. Explains the purpose of valuation, discussing the fair rate of return, and the principal methods used in valuations of properties. 5000 w. Eng News —Feb. 2, 1911. No. 20822.

Logical Basis for Valuations of Interurban Street Railways. C. G. Young. Abstract of paper before the Cent. Elec. Ry. Ass'n. Analysis of the purposes of a valuation, method of determining a fair rate of return, the principal methods used in valuations of properties, etc. 3000 w. Elec Ry Jour—Jan. 21, 1911. No. 20295.

Vienna.

The Electrification of the Vienna Stadtbahn (Referat zur Frage der Elektrifizierung der Wiener Stadtbahn). J. Seidener. Paper and discussion before the Vienna Electrical Society. Points out the advantages of electrical operation of the municipal railway. Ills. 6400 w. Elektrotech u Maschinenbau—Dec. 11, 1910. No. 20498 D.

EXPLANATORY NOTE—THE ENGINEERING INDEX

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language,* together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cts. The letter A, B, or C denotes a price of 40 cts.; D, of 60 cts.; E, of 80 cts.; F, of $1.00; G, of $1.20; H, of $1.60. When the letter N is used it indicates that copies are not readily obtainable and that particulars as to price will be supplied on application. Certain journals, however, make large extra charges for back numbers. In such cases we may have to increase proportionately the normal charge given in the Index. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

Serial publications are indexed on the appearance of the first instalment.

SPECIAL NOTICE.—To avoid the inconvenience of letter-writing and small remittances, especially from foreign countries, and to cheapen the cost of articles to those who order frequently, we sell coupons at the following prices:—20 cts. each or a book of twelve for $2.00; three books for $5.00.

Each coupon will be received by us in payment for any 20-cent article catalogued in the Index. For articles of a higher price, one of these coupons will be received for each 20 cents; thus, a 40-cent article will require two coupons; a 60-cent article, three coupons; and so on. The use of these coupons is strongly commended to our readers. They not only reduce the cost of articles 25 per cent. (from 20c. to 15c.), but they need only a trial to demonstrate their very great convenience—especially to engineers in foreign countries, or away from libraries and technical club facilities.

Write for a sample coupon—free to any part of the world.

CARD INDEX.—These pages are issued separately from the Magazine, printed on one side of the paper only, and in this form they meet the exact requirements of those who desire to clip the items for card-index purposes. Thus printed they are supplied to regular subscribers of THE ENGINEERING MAGAZINE at 10 cents per month, or $1.00 a year; to non-subscribers, 25 cts. per month, or $3.00 a year.

THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the index. In the list below, *w* indicates a weekly publication, *b-w,* a bi-weekly, *s-w,* a semi-weekly, *m,* a monthly, *b-m,* a bi-monthly, *t-m,* a tri-monthly, *qr,* a quarterly, *s-q,* semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated; W—Words; Anon—Anonymous.

Alliance Industrielle. *m.* Brussels.
American Architect. *w.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Jl. of Science. *m.* New Haven, U. S. A.
American Machinist. *w.* New York.
Annales des Ponts et Chaussées. *m.* Paris.
Ann. d Soc. Ing. d Arch Ital. *s-m.* Rome.
Architect. *w.* London.
Architectural Record. *m.* New York.
Architectural Review. *s-q.* Boston.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Melbourne.
Autocar. *w.* Coventry, England.
Automobile. *w.* New York.
Automotor Journal. *w.* London.
Beton und Eisen. *qr.* Vienna.
Boiler Maker. *m.* New York.
Brass World. *m.* Bridgeport, Conn.
Brickbuilder. *m.* Boston.
Builder. *w.* London.
Bull. Bur. of Standards. *qr.* Washington.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bull. of Can. Min. Inst. *qr.* Montreal.
Bull. Soc. Int. d'Electriciens. *m.* Paris.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bull. Int. Railway Congress. *m.* Brussels.
Bull. Scien. de l'Assn. des Elèves des Ecoles Spéc. *m.* Liége.
Bull. Tech. de la Suisse Romande. *s-m.* Lausanne.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *w.* Toronto and Montreal.
Canadian Mining Journal. *b-w.* Toronto.
Cassier's Magazine. *m.* New York and London.
Castings. *m.* Cleveland, O.
Cement. *m.* New York.
Cement Age. *m.* New York.
Central Station. *m.* New York.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Colliery Guardian. *w.* London.
Commercial Vehicle. *m.* New York.

Compressed Air. *m.* New York.
Cornell Civil Engineer. *m.* Ithaca.
Deutsche Bauzeitung. *b-w.* Berlin.
Die Turbine. *s-m.* Berlin.
Domestic Engineering. *w.* Chicago.
Economic Geology. *m.* New Haven, Conn.
Electrical Engineer. *w.* London.
Electrical Engineering. *w.* London.
Elec. Review and W. Elec'n. *w.* Chicago.
Electrical Review. *w.* London.
Electric Journal. *m.* Pittsburg, Pa.
Electric Railway Journal. *w.* New York.
Electrical World. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.
Elektrische Kraftbetriebe u Bahnen. *w.* Munich.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnik u Maschinenbau. *w.* Vienna.
Elektrotechnische Rundschau. *w.* Potsdam.
Elettricità. *w.* Milan.
Engineer. *w.* London.
Engineering. *w.* London.
Engineering-Contracting. *w.* New York.
Engineering Magazine. *m.* New York and London.
Engineering and Mining Journal. *w.* New York.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penna. *m.* Pittsburg, U. S. A.
Far Eastern Review. *m.* Manila.
Foundry. *m.* Cleveland, U. S. A.
Génie Civil. *w.* Paris.
Giesserei-Zeitung. *s-m.* Berlin.
Glasers Ann. f Gewerbe & Bauwesen. *s-m.* Berlin.
Heating and Ventilating Mag. *m.* New York.
Horseless Age. *w.* New York.
Ice and Cold Storage. *m.* London.
Ice and Refrigeration. *m.* New York.
Il Cemento. *s-m.* Milan.
Industrial World. *w.* Pittsburg.
Ingegneria Ferroviaria. *s-m.* Rome.
Ingenieur. *w.* Hague.
Insurance Engineering. *m.* New York.
Int. Marine Engineering. *m.* New York.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron Trade Review. *w.* Cleveland, U. S. A.
Jour. of Accountancy. *m.* N. Y.
Journal Am. Soc. of Engineering-Contractors. *m.* New York.
Journal Asso. Eng. Societies. *m.* Philadelphia.
Journal Franklin Institute. *m.* Philadelphia.
Jour. N. E. Water Works Assn. *qr.* Boston.
Journal Royal Inst. of Brit. Arch. *s-q.* London.
Jour. Roy. United Service Inst. *m.* London.
Journal of Sanitary Institute. *qr.* London.
Jour. of South African Assn. of Engineers. *m.* Johannesburg, S. A.
Journal of the Society of Arts. *w.* London.
Jour. Transvaal Inst. of Mech. Engrs., Johannesburg, S. A.
Jour. of U. S. Artillery. *b-m.* Fort Monroe, U. S. A
Jour. W. of Scot. Iron & Steel Inst. *m.* Glasgow.
Journal Western Soc. of Eng. *b-m.* Chicago.
Jour. of Worcester Poly. Inst., Worcester, U. S. A.
Locomotive. *m.* Hartford, U. S. A.
Machinery. *m.* New York.
Manufacturer's Record. *w.* Baltimore.
Marine Review. *m.* Cleveland, U. S. A.
Mechanical Engineer. *w.* London.
Mechanical World. *w.* Manchester.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Metallurgical and Chem. Engng. *m.* New York.
Métallurgie. *w.* Paris.
Metal Worker. *w.* New York.
Mines and Minerals. *m.* Scranton, U. S. A
Mining and Sci. Press. *w.* San Francisco.
Mining Journal. *w.* London.
Mining Magazine. *m.* London.
Mining World. *w.* Chicago.
Mittheilungen des Vereins für die Förderung des Local- und Strassenbahnwesens. *m.* Vienna.
Municipal Engineering. *m.* Indianapolis. U. S. A.
Municipal Journal and Engineer. *w.* New York.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Oest. Wochensch. f. d. Oeff. Baudienst. *w.* Vienna.
Oest. Zeitschr. Berg- & Hüttenwesen. *w.* Vienna.
Power and The Engineer. *w.* New York.
Practical Engineer. *w.* London.
Pro. Am. Ins. Electrical Eng. *m.* New York.
Pro. Am. Ins. of Mining Eng. *m.* New York.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Pro. Am. Soc. Mech Engineers. *m.* New York.
Pro. Canadian Soc. Civ. Engrs. *m.* Montreal.
Proceedings Engineers' Club. *qr.* Philadelphia.
Pro. Engrs. Soc. of Western Pennsylvania. *m.* Pittsburg.
Pro. St. Louis R'way Club. *m.* St. Louis, U. S. A.
Pro. U. S. Naval Inst. *qr.* Annapolis, Md.
Progressive Age. *s-m.* New York.
Public Works. *qr.* London.
Quarry. *m.* London.
Queensland Gov. Mining Jour. *m.* Brisbane, Australia.
Railway Age Gazette. *m.* New York.
Railway and Engineering Review. *w.* Chicago.
Railway and Loc. Engng. *m.* New York.
Railway Master Mechanic. *m.* Chicago.
Revue d'Electrochimie et d'Electrométallurgie. *m.* Paris.
Revue de Mécanique. *m.* Paris.
Revue de Métallurgie. *m.* Paris.
Revue Gén. des Chemins de Fer. *m.* Paris.
Revue Gén. des Sciences. *w.* Paris.
Revue Industrielle. *w.* Paris.
Rivista Marittima. *m.* Rome.
Rudder. *m.* New York.
Schiffbau. *s-m.* Berlin.
School of Mines Quarterly. *q.* New York.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Sibley Jour. of Mech. Eng. *m.* Ithaca, N. Y.
Signal Engineer. *m.* Chicago.
Soc. Belge des Elect'ns. *m.* Brussels.
Southern Electrician. *w.* Atlanta, Ga.
Stahl und Eisen. *w.* Düsseldorf.
Stevens Institute Indicator. *qr.* Hoboken, U. S. A.
Surveyor. *w.* London.
Technique Moderne. *m.* Paris.
Tramway & Railway World. *m.* London.
Trans. Inst. of Engrs. & Shipbuilders in Scotland, Glasgow.
Wood Craft. *m.* Cleveland, U. S. A.
Yale Scientific Monthly. *m.* New Haven.
Zeitschr. f. d. Gesamte Turbinenwesen. *w.* Munich.
Zeitschr. d. Mitteleurop. Motorwagen. Ver. *s-m.* Berlin.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschr. f. Werkzeugmaschinen. *b-w.* Berlin.

CURRENT RECORD OF NEW BOOKS

NOTE—*Our readers may order through us any book here mentioned, remitting the publisher's price as given in each notice. Checks, Drafts, and Post Office Orders, home and foreign, should be made payable to* THE ENGINEERING MAGAZINE.

Electric Trains.

Electric Trains. By H. M. Hobart. Size, 8½ by 5½ in.; pp., xix, 201. Ills. Price, $2.50. New York: D. Van Nostrand Company.

In this volume, Mr. Hobart confines his treatment of the subject of electric traction to electric trains for city and suburban service, presumably reserving electric locomotives for consideration in a future work. The work is a thoroughly practical discussion of the main factors governing the design and operation of electric trains and can be recommended as a condensed, but at the same time comprehensive and lucid, presentation of the subject. Especial interest attaches to Mr. Hobart's exposition of the method of arriving at the approximate cost of electrical equipment and operation, which he believes is here rationally set forth for the first time.

Municipal Chemistry.

Municipal Chemistry. Edited by Charles Baskerville. Size, 9 by 6 in.; pp., 526. Ills. Price, $5. New York and London: McGraw-Hill Book Company.

A series of thirty lectures by experts on the application of the principles of chemistry to the city, delivered at the College of the City of New York during 1910. The list of lecturers and the subjects with which they dealt is as follows: Charles Baskerville — sanitation and the city; William Pitt Mason — drinking water and disease, and water purification; Alfred Douglas Flinn—the Catskill water supply for New York City; Thomas C. Darlington — milk; Harvey W. Wiley — food adulteration (two lectures); William Allen Hamor—food inspection; Virgil Coblentz—drug adulteration (two lectures); Lyman F. Kebler—habit-forming agents; Allerton S. Cushman—streets and roads (two lectures); William H. Edwards — street sanitation; Edward D. Very—street cleaning and waste disposal (three lectures); C. E. A. Winslow — sewage disposal; Arthur H. Elliott—illuminating gas (two lectures); Payn B. Parsons—the smoke problem; Herbert R. Moody—ventilation; Thomas A. Storey—personal hygiene; Louis A. Olney—textile materials; A. A. Breneman — combustibles and explosives (two lectures); Maximilian Toch — paint, corrosion of iron and steel, and cement and concrete; and Nathaniel Lord Britton—parks, gardens and playgrounds.

Rock Drills.

Rock Drills: Design, Construction and Use. By Eustace M. Weston. Size, 9 by 6 in.; pp., 367. Ills. Price, $4. New York and London: McGraw-Hill Book Company.

The author's object in preparing this book has been to describe the leading modern makes of English, Australian and American drills of both piston and hammer types, and to give such details of their actual use in metalliferous mines as will enable a novice to approach them with some previous knowledge, and also will assist the engineer and mine manager to choose machines best suited to his particular needs and to maintain and work them at their highest efficiency. While he has not hesitated to borrow freely from the writings of others, much of the work is based upon his own experience in working many of the drills described. He has consistently kept in view the needs of the practical man, and while the book may be open to criticism for the omission of some subjects and the scant treatment given to others, we know of no more useful and exhaustive work on the subject of rock drills. The chapter headings are: Historical Sketch; Standard Piston Drills; Hammer Drills; Electric Drills; Operating Rock Drills on the Surface and Underground; Piston Drills Designed to Use Air Expansively; Philosophy of the Process of Drilling Rock; Repair and Maintenance of Rock Drills; Drill Steel and Drill Bits; Explosives and Their Use; Theory of Blasting with High Explosives; Examples of Rock Drill Practice, Africa, Australia and America; Rock Drill Tests and Contests; Dust and Its Prevention; and Notes on the Use of Compressed Air.

IMPROVED MACHINERY

NEW METHODS
NEW PROCESSES
NEW MATERIALS
NEW APPLIANCES

The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

Automatic Reversing Trippers.

New York, January 22, 1911.

To the Editor,
The Engineering Magazine.

Dear Sir:—

Our attention has just been called to an article on Page IX of your department of Improved Machinery for January, describing and illustrating an automatic reversing tripper which, according to the article, is made by the Stephens-Adamson Manufacturing Co. of Aurora, Ill.

This machine is described as a "new" automatic reversing tripper. Your article contains such a full and detailed description of the mechanism that we are able to say with certainty that the device infringes every one of the twelve claims of our Patent No. 673,539 of May 7th, 1901, covering a tripper invented by the late Mr. James Barnes Humphreys, who was for several years the chief engineer of this company. We ask you to examine the picture and description of the tripper referred to in your article and satisfy yourself that there is not a single mechanical detail which is not fully shown and described in our patent of ten years ago, which we send herewith.

Our company has built hundreds of trippers under this patent, every one of which is plainly marked with the patent number. We have also had full sized machines of this type operating at all of the large World's Fairs since the Paris Exposition of 1900, where we received the only Grand Prix which was awarded for conveying machinery. Furthermore, this same tripper is illustrated and described fully in our earlier catalogues. Therefore, we are compelled to attribute to audacity rather than to ignorance, the claims made by the Stephens-Adamson Company in your pages that they are offering a "new" automatic reversing tripper, and that "there has been a great need in certain classes of work for a tripper of this sort."

Several years ago our company discontinued, to some extent, the use of the friction drive for moving the tripper, and substituted wherever it was possible a mechanical equivalent which is absolutely dust-proof, thereby saving our customers the expense of renewing the friction wheels. But the fact that we do not commonly employ a mechanical detail which was tried and found wanting, offers no excuse for any one to use your pages in order to foist upon the public as original and new, a device which has been patented for ten years in every civilized country on the globe, and which has been advertised and sold in large numbers by the most prominent concern in its line of business.

The matter of infringement of our rights is one which we can look after with the help of our attorneys; but the damage, and particularly the annoyance, which we shall suffer from the article in your journal are serious matters. We are sure you will agree that such an article breeds other infringements, and attracts trade away from those to whom it rightfully belongs. We therefore trust that you will give this letter as much prominence as was accorded in your columns to the article to which we have made objection.

Yours very truly,
Robins Conveying Belt Co.,
Thomas Robins, President.

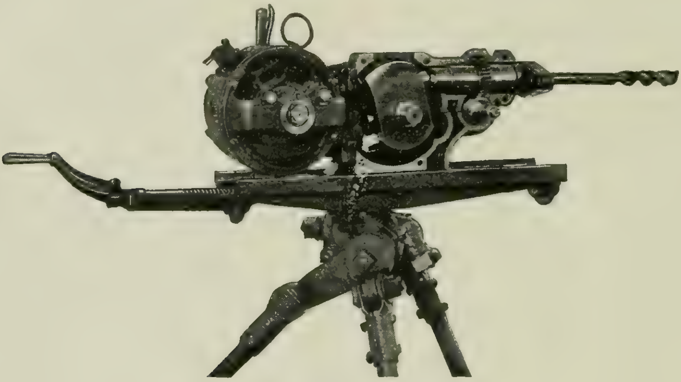
The Fort Wayne Rock Drill.

THE Fort Wayne type "A" electric rock drill is the result of several years development and testing under the most severe and unfavorable conditions of actual working operations. Contrasted with designs making use of flexible shafts, solenoids, springs and other complicated devices, the Fort Wayne drill is unusually simple, and consequently it is exceedingly rugged and effective.

This drill is of the rotary hammer type, operated by an electric motor which is mounted on the frame of the drill proper. The mechanism of the drill consists of two parts, a revolving helve containing the hammers, and the chuck mechanism for holding and rotating the drill steel. An idler is conveniently arranged in connection with the flexible belt between motor and drill, which provides a means of regulating the speed of the drill. Thus all the advantages of hand drilling are obtained without the disadvantages usually incident to machine drilling.

The drill steel is held in the chuck by means of several spring steel plates. When not striking rock, the blow from the hammer is absorbed by these buffer plates, which also retain the steel in the chuck while "backing out" of deep holes or in broken and uneven ground.

The drill casing, striking mechanism, chuck and buffer plates are all simple and very substantial. The floating hammers in the helve are of special steel and are completely cushioned by air chambers so that the jar of the impacts is reduced to a minimum.



The drill steel cannot be jammed into a fissure or cleavage crack as a result of several conditions. Should a fissure be encountered the buffer head prevents the drill steel from being plunged forward. The drill steel is not reciprocating and before it can be fed far enough into a fissure to wedge, it has hammered for itself a square shoulder or face, due to the rapidity of the blows in connection with the constant and positive rotation of the drill steel. The resultant effect approaches that of boring.

Another point of excellence in the

Fort Wayne drill is the simple method employed for the removal of cuttings from the hole being drilled. A special designed steel removes the cuttings by a boring action and does away with the use of hollow drills or water under pressure. Thus the big item of pressure systems, including tanks, hose, water lines, etc., is eliminated, as well as the cost of maintenance and inconvenience incident to such systems.

While these drills are ordinarily used in a horizontal position, they can be used in any position and will drill holes at any angle.

The ease with which power can be transmitted throughout the workings by wire, and the rapidity with which the lines can be changed, enables the operator to advance his work more rapidly than could be done when using other types of drills. A comparison of tests of the type "A" drill and air drills shows that the former requires about 1½ to 2 horse power, including transmission loss, while an average air drill requires from 12 to 18 horse power for the same work. This is due to the design of the drill, the much greater efficiency of the electric motor, and the small loss in transmitting power to the drill. The simplicity and ruggedness of design of the type "A" drill is a guarantee that the cost of maintenance will be exceedingly low. Owing to the saving in power, the low cost of maintenance and the high efficiency of the Fort Wayne drill, from 50 to 70 per cent. can readily be made, under ordinary conditions, upon the investment.

The drill can be operated with either an AC or DC motor and since the motor is entirely independent of the drill the change from one to the other is easily made.

Bulletin No. 1120 issued by the Fort Wayne Electric Works, 1630 Broadway, Fort Wayne, Ind., illustrates and describes this drill in detail. It is sent free on request.

Automatic Fuel Oil Regulation.

PRACTICALLY all oil fired boiler plants are controlled by hand. Steam as well as oil is regulated at each individual burner, and the dampers are also subject to hand control. Results obtained are hardly ever satisfactory, thereby lowering the efficiency of the boiler plant.

The first notable step in advance of hand firing was at the plant of the Pacific Electric Railway Co., Los Angeles, Cal., where under the directions of the chief engineer, one man stationed near the oil pumps, running at practically constant speed, controlled 18 boilers or 54 burners by opening or closing a bleeder valve on the oil pump discharge line, thereby increasing or decreasing the pressure in the oil main and simultaneously the rate of firing of all the boilers. After this it was a simple matter to substitute automatic regulation for hand control, thereby developing the Moore automatic fuel oil regulating system. This system controls the supply of oil to all burners, the supply of the atomizing agent to all burners, and the supply of air for combustion, for any number of boilers, all from a central point. The results are increased boiler plant efficiency, the practical prevention of smoke, and the decrease in the maintenance cost of boiler equipment, due to a more uniform manner of firing. This was first installed at the Redondo plant of the Pacific Light & Power Co. in 1907. Here the regulating system is used to control the entire plant of 18 boilers of 600 horse power capacity each, and the increased economy, due to uniform rate of firing, is very evident.

Under actual operating conditions this system of regulation has been found absolutely reliable. In 1909, or about two years after this apparatus was installed, A. C. Balch, general manager of the Pacific Light & Power Co., expressed his opinion in the following letter to the designers:

"As you know, we have in our plant at Redondo, 18 Babcock & Wilcox boilers, each rated at 604 horse power, with three burners per boiler, or 54 burners in all. The entire boiler plant has now been equipped with the Moore automatic fuel oil regulators for the past year, which control the steam pressure, the fuel oil pressure, the supply of steam to burners for atomizing the oil, and the operation of boiler dampers for the purpose of regulating the supply of air for combustion.

"With this system we maintain practically a uniform pressure while in operation. One-third of the plant has been under automatic control for a period of over 18 months. The remainder as stated above, was equipped with your regulators one year ago and the entire plant is now operating under this condition. During this time we have never suffered an interruption of service, or loss of steam pressure, due to failure of regulators to operate; they are simple in design and positive in action and we find them capable of ready adjustment by the operative firemen.

"Our plant is subject to a widely swinging railway load and we find under all conditions the boilers respond to these fluctuations of load almost instantly. As the result of installing this equipment we find the load is more equally divided among all of the boilers in service than under hand firing, and the boilers are free from abuses due to excessive rate of firing periodically experienced with hand regulation on variable load.

"It is usually the case, in attempting to hand regulate fires on reduced air supply, that the chimneys will smoke frequently on variation in loads; as a result of the automatic system of regulation, the smoke nuisance has been reduced to a minimum."

At this time, 1911, after this system has been in operation a number of years, the Southern California Edison Co. is installing a similar outfit. A bulletin "Unnecessary Losses in Firing Fuel Oil and an Automatic System for Eliminating Them," can be obtained on writing to Chas. C. Moore & Co., San Francisco Cal.

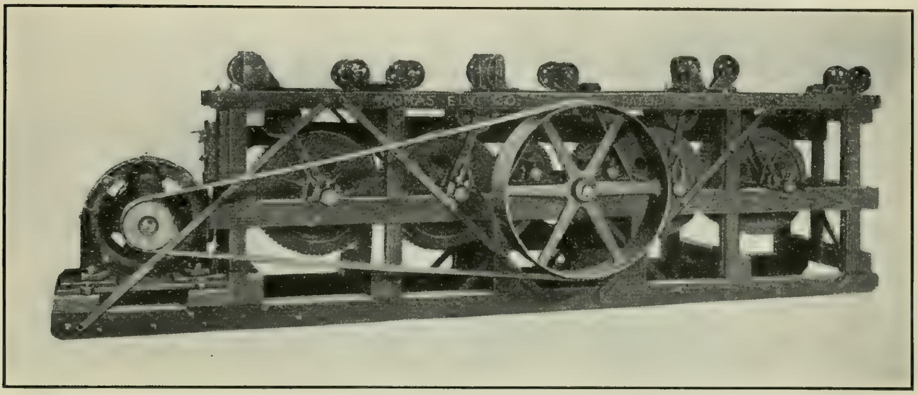
Eight Spool Caisson Hoist.

UP to the present time hoisting from caissons has been done with the ordinary hoisting engine equipped with governor and cable driving sheaves. A spool is located at each caisson and an endless cable is carried from the hoist sheave around the several caisson spools operating them in series.

With this equipment it is necessary that the caissons be either aligned or that a combination of sheaves be installed to spring the cable to the proper direction. In this installation a fouled line at any caisson stops all work on the series until the line is straightened or repaired. It not infrequently happens also that the driving cable breaks, with the result that all buckets are precipitated to the bottom and often injuring the workmen. There is another disadvantage in the fact that in the usual work only a part of the caissons are completed at one time and a portion of the plant and workmen must remain idle while the remaining caissons are being finished, or the hoisting from the incompleted caissons must be done by hand.

The improved caisson hoist, shown herewith, obviates all of the above difficulties. The material from each caisson is hoisted independently. There is no necessity for alignment of caissons as the machine provides a separate hauling line to each caisson and operates with equal facility in any direction. A caisson located at any place in the foundation therefore can be started at any time desired.

Since each caisson is operated independently, any breakage or cessation of work does not interfere in any manner with the progress in the other caissons. A slow or difficult caisson, also, does not impede the work in the other caissons.



Any hoist speed of load may be had from 0 to 150 feet per minute and the speed is under the absolute control of the operator at the caisson. An accident in any line, therefore, will not affect any other. The hauling line is so carried that it does not slip on a spool and burn out; the slippage is entirely on a friction disc, built for the purpose, and the line and frictions are therefore practically indestructible.

One set up on any ordinary size building is sufficient to complete the job. Caissons located as far as 100 feet radius can be operated with ease.

This hoist is made by Thomas Elevator Co., 20 South Hoyne avenue, Chicago, Ill., who will furnish full information respecting it on request.

Durability of Metal Roofs.

MANUFACTURERS are daily giving more attention to the minimizing of factory costs and the costs of maintenance and general factory wear and tear, and for years big manufacturers have been looking for a roofing material that would stand the exposure to the smoke and grime-laden atmosphere of manufacturing districts. A number of the larger plant owners in various parts of the country are using Toncan Metal, a rust-resisting product made by the Stark Rolling Mill Company of Canton, Ohio, in the roofing of their plants. Among the large factories in the country which have replaced old rust-eaten, corroded iron and sheet steel roofs with Toncan Metal are the Union Rolling Mill Company of Cleveland, Ohio; Ball Brothers, glass manufacturers of Muncie, Ind., and the Seneca Chain Company of Kent, Ohio.

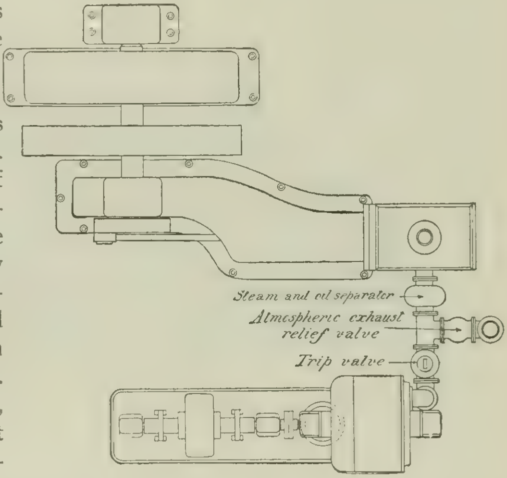
Durability is the chief requisite in a metal roof. It costs thousands of dollars to cover acre after acre of factory roof with steel and iron that offer little resistance to adverse weather and other conditions which work toward early rusting and corrosion. It has been the experience of many that roofing material has had to be replaced yearly. The Union Rolling Mill Company is one of the largest concerns of its kind in the country. In 1907 they adopted Toncan Metal for roofing purposes, 1,300 squares or 130,000 square feet being placed on the factory roof during 1907, 1908, 1909 and 1910. Previous to that time it was necessary to replace portions of the roof on an average of once a year, but since the first installment of this new metal roof it has not been necessary to replace any of it. The roof is as good to-day as it was the day it was put on, because the weather conditions and the sulphurous conditions arising from the mixture of smoke and fumes do not corrode it as did the roofing material previously used.

The Seneca Chain Company, one of the largest chain manufacturing concerns in the world, is erecting a large plant at Kent, Ohio. In erecting a new plant to replace the one recently destroyed by fire, they specified and used Toncan Metal for roofing and siding on the entire plant. The Ball Bros. Mfg. Co., at Muncie, Ind., one of the largest, if not the largest manufacturers of fruit jars, has found it economical to use Toncan Metal sheets not only for roofing and siding on their immense plant but also in connection with their manufacturing operations.

Steam Turbines With Reciprocating Engines.

To increase the power of a plant where the requirements have slightly outgrown its original capacity is a trying problem that is often made easy by means of the exhaust steam turbine. This is well illustrated for instance in a mill deriving its power from a simple non-condensing engine, and in which the addition of machinery from time to time has increased the load on the engine beyond a practical limit.

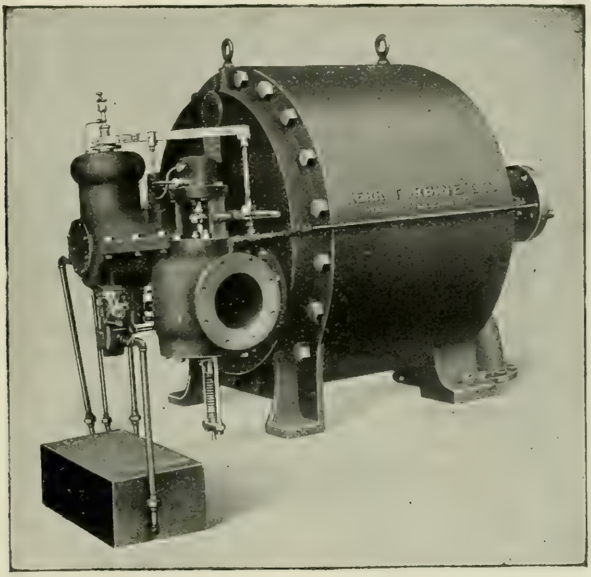
Changing the engine to condensing and utilizing the additional range of pressure drop to drive an exhaust steam turbine, not only almost doubles the amount of power previously secured from the engine, but this is done without increasing the duty on the engine and without using more steam than before. Such an installation is illustrated herewith. The initial cost of the turbine and condenser per horse power is less than for additional boiler and engine capacity, and there is not the compulsion to buy more than may be required.



The second illustration shows a Kerr exhaust turbine, made by Kerr Turbine Co., Wellsville, N. Y. This machine operates with any steam pressure above 2 pounds gauge at its inlet and exhausts into a vacuum of from 24 to 28 inches utilizing exhaust from main engine, pumps, air compressors, etc.

The installation of such an exhaust turbine improves the economy most and offers the greatest capacity increase where the turbine and a suitable condenser are added to a simple non-condensing engine. For the smaller sizes the ordinary jet condenser maintaining

24 to 26 inches vacuum may be used with satisfaction. In larger units condensing apparatus maintaining higher vacuum is justified. A substantial improvement in economy and increase in capacity also result from the addition of an exhaust turbine to a simple condensing engine and from the addition of turbine and condenser to a compound non-condensing engine.



In general the steam economy of a simple engine and exhaust steam turbine together is always an improvement over that which would be obtained by compounding and adding a condenser. The plant capacity is increased from 50 to 100 per cent. by exhausting through an exhaust turbine to condenser on a non-condensing engine, while the increase by adding the turbine to a condensing outfit is from one and one-half to three times that which could be secured from the condenser alone.

As an engine and exhaust turbine installation takes no more steam than would the engine alone and under the same conditions as before, there is not an additional penny of expenditure necessary for boilers, chimneys, draft, coal handling apparatus, buildings and steam piping. The turbine and condenser, or turbine alone in a condensing plant, can be cut into the exhaust line without interfering with the engine and usually without otherwise altering the layout of the plant. The installation of the turbine hardly affects plant operating costs as the turbine is adjusted at the factory and seldom requires other attention than occasional lubrication and repacking of stuffing boxes. The oiler who has previously been taking care of the engine can look after the turbine too without any serious drain on his time, for the turbine should run constantly for months without shutdown.

An engine that has previously been running non-condensing, continues to exhaust at about the same pressure and carries the same load after the turbine is put into the exhaust line. A condensing engine can be adjusted to exhaust at atmospheric pressure or thereabouts and will be relieved of that part of the load assumed between atmospheric pressure and the vacuum while the turbine is being operated. The water of condensation will be discharged from the condenser at a temperature within two or three degrees of the theoretical and can be utilized in the usual ways.

In short, the increase in output obtained from a condensing reciprocating engine and exhaust set is greater by about 25 per cent. than obtainable with any condensing engine alone while the installation of turbine and condenser upon a non-condensing engine increases the output from about 40 to 100 per cent.

Power developed by an exhaust steam turbine is available for driving a generator, centrifugal or air pump, fan or any high speed machine or for belt or silent chain driving, and under much the same conditions as that obtainable from high pressure turbines. Rigged up for belt or chain drive, the exhaust turbine delivers into the same line or jack shaft as the engine, in which case the turbine assumes an almost fixed proportion of the load. Figure 3 is a typical installation of this kind. The output of the turbine may be delivered entirely independent of the engine to drive belted auxiliaries or machinery of any kind, the speed requirements of the driven machine being perfectly met by a conforming pulley ratio.

Cameron-Ingersoll-Rand Consolidation.

THE recent change in the proprietorship of the A. S. Cameron Steam Pump Works from the widow of the founder to the Ingersoll-Rand Company has excited a good deal of attention and some misunderstanding. As a matter of fact the Ingersoll rock drill and the Cameron pump have always been very closely associated, each being about the same age, forty years. In a little shop on the corner of Second avenue and Twenty-second street, New York, both the Ingersoll drill and the Cameron pump originated, and for some years the manufacture of both took place under the same roof. The late Henry C. Sergeant designed the first really successful Ingersoll drill, getting his fundamental ideas of the valve motion from A. S. Cameron This was at a time when even the fly-wheel engine was more or less of a novelty, and a reciprocating engine, like a pump or rock drill, with no crank shaft to carry it around the center, was practically unknown. The first machines of this class were built on steam engine lines, the valve itself being mechanically connected with the piston. In the first Ingersoll drill, as in the first pump, when the piston reached the end of the stroke it reversed the valve by direct mechanical contact with knuckle joints, rods or other devices, which intervened between the piston and the valve.

Here is where great credit is due to A. S. Cameron. He was seeking to perfect a pump which should be used in rough places where exposed parts were liable to wear and injury. He also wanted to build a valve which would open up a large port at the end of the stroke at the instant that the piston reached a certain point. This was hardly practicable with a mechanically moved valve without excessive shock and wear. Cameron's invention, therefore, was to place a small tappet or knuckle in each cylinder head of the pump, which would serve as a trigger to trip through contact with the piston and open a small port connecting either end of the valve. The valve itself was submerged in live steam pressure equal at both ends, hence when this tripping action took place it reduced the pressure on one end so that the active pressure on the other caused it to reverse. In order to do this with the minimum shock at the tappet, or with a small trigger action, and also taking into consideration the importance of having a small port controlled by such action, Mr. Cameron used a plunger piston which in turn overlapped the valve itself, this plunger piston having an area on each end which might be greater or smaller according to the resistance of the valve to the action of sliding on its seat. The valve itself was, and still is, a slide valve which, as everybody knows, rests tightly upon its ports and does not leak by wear.

Sergeant had a problem more difficult than Cameron, because, in the first place, the speed of a pump is only about 100 feet per minute, while that of a rock drill is four times as great. This high speed made it difficult to use any kind of a tappet trigger, and in order to get the quickest action of the valve, Sergeant sought to obtain the slide valve and to use the plunger or valve moving device of Cameron as the valve itself. In doing this he ran against another difficulty;—the valve, in order to be tight on its seat, would press so hard that the speed of the drill became sluggish. To overcome this he ran a bolt through the center of this valve, which relieved it of a certain portion of this pressure. Instead of the tappet trigger Sergeant moved his valve by causing the piston of the drill to uncover passages leading to each valve end. Here we have the identical principle, so far as the valve movement is concerned, that is embodied in the Cameron pump, namely, an equal pressure on both ends of the valve and the valve moving through a disturbance of that pressure on one end and the other alternately, the action itself being controlled by the strokes of the piston. No better evidence is needed of the success of this valve action than the fact that the Ingersoll "Eclipse" drill and the Cameron pump are at work today with valves of this construction.

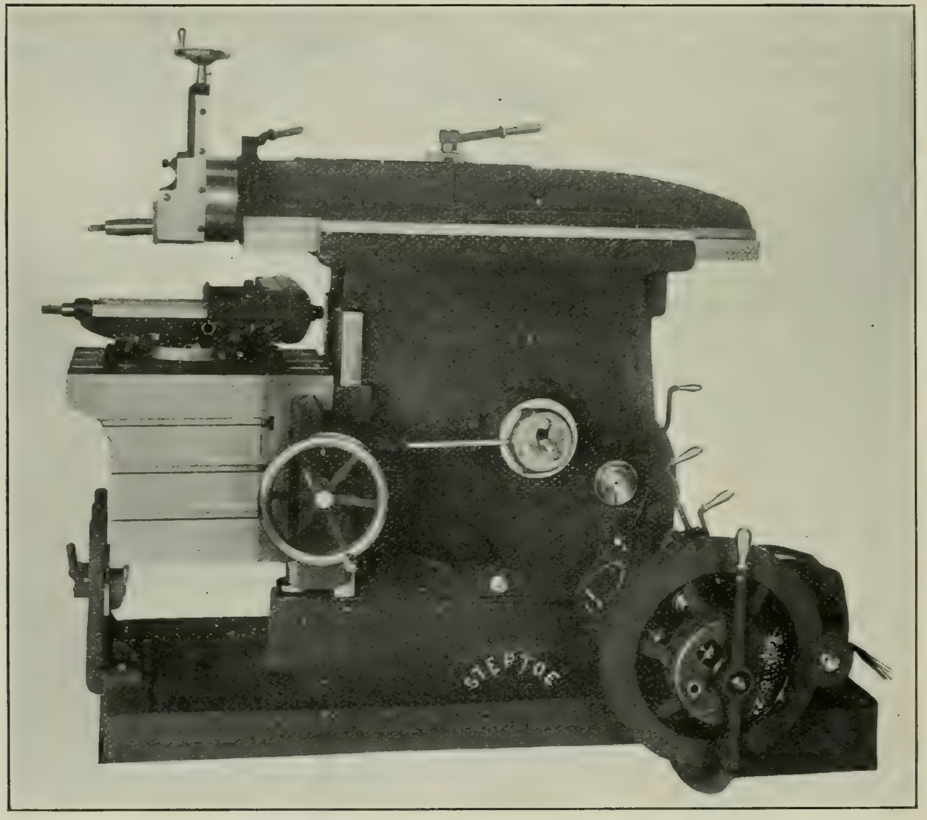
The community of interests between Cameron and Ingersoll has extended from this inception to the present day. The castings for the first air compressors of the Ingersoll make were made in the Cameron foundry on East Twenty-second street. For many years, and until the Ingersoll works were moved to Easton, Pa., the castings were made by Cameron. The success of the Cameron pump in mines, quarries and for contractor's service, brought it close to the Ingersoll business. In South Africa, and other places, the Ingersoll-Rand agents have been the agents for the Cameron pump.

Adam Scott Cameron graduated from Cooper Institute and applied himself to mechanical matters. He was engaged in building the Sewell and Cameron crank and flywheel pump, which during the Civil War was in demand by the United States Navy and the Merchant Marine. At the close of the war the call for these pumps fell off so that Mr. Cameron turned his attention to the design of a pump of greater adaptability and more general application. The standard Cameron pump was the result, its acorn-shaped air chamber, the emblem of the clan Cameron, the oak, being his trade mark and continuing up to the present time. He died at an early age, but he had stamped his ability and force of character upon the mechanical engineering of his age. His widow carried on the business up to a recent date, the management being for the past eleven years in charge of George Ward Fuller, to whom much credit is due for the successful introduction of the Cameron pump throughout the world. Mr. Fuller continues as vice-president and general manager of the company; George Doubleday, who is first vice-president of the Ingersoll-Rand Company, being president, and the directorate being composed of Mr. Fuller and the directors of the Ingersoll-Rand Company.

Motor Driven Crank Shaper.

THE accompanying illustration shows a new motor driven crank shaper with speed box, made by the John Steptoe Shaper Co., Jessamine Station, Cincinnati, Ohio. The drive consists of a small gear on the motor with a large gear on the speed box shaft. Four changes of speed are secured through the speed box, and by means of the back gears, eight changes are secured.

The machine can be stopped or started by means of a clutch which operates in the hub of the large gear. One pound pressure on the clutch lever gives 128 pounds pressure on the ring, so that the machine can be started or stopped almost without effort on the part of the operator. It can be operated by means of the thumb and first finger of the right hand. All of the clutch mechanism is fully enclosed, thus avoiding the possibility of the operator getting caught, and doing away with the possibility of accidents.



All the bearings in the speed box are equipped with ring oilers, which keep the shafts constantly flooded in oil. Spiral oil channels are chased in the shaft to insure the proper distribution of the oil over the entire bearing. The speed box is so arranged that no clutches are used, and there are, therefore, no gears running idle on the shaft, avoiding any possibility of noise or wear on the hole in the gears. When one gear is shifted in position, the other is shifted out, thereby making a very effective drive, and reducing the wear to a minimum. The only wear on our gears is when they are in actual operation, and all gears are keyed to the shaft.

The motor used is a General Electric 3 horse power, constant speed, running about 1,200 revolutions per minute.

A large bush is provided where the driving shaft from the shaper enters the speed box. This bush enters the column of the shaper and also the speed box bearing. The driving shaft is therefore relieved of any possible strain that might come from the speed box, as such strain would come directly on the bush provided for that purpose. This bushing is provided with ring oilers both in the column of the shaper and in the speed box. The intermediate shaft in the shaper is also provided with ring oilers and bushings, which can be readily removed and replaced at any time should it become necessary. The speed box is supported by means of a heavy brace, projecting from the base of the shaper.

This drive is so simply constructed, that there is nothing on it which can get out of order. The motor is set on a subbase, which is cast onto the base of the shaper. The motor is therefore set on a very solid foundation, and avoids the possibility of shaking the machine when running, thereby preventing chatter marks on the work which is being planed.

A Large Pumping Contract.

ONE of the largest contracts for pumping machinery ever placed has been awarded to the Alberger Pump Company of New York City by the Bureau of Yards and Docks, the total sum involved being slightly over $323,000. The contract covers pumping equipment for the three new dry docks to be constructed by the Government at New York, Puget Sound and Pearl Harbor Navy Yards, and include all told eleven 54 inch vertical volute pumps, each direct connected to a 550 horse power induction motor, and seven 15 inch vertical volute drainage pumps, each direct connected to an 85 horse power induction motor; also all necessary suction and discharge piping, electrically operated gate valves for the same and all electrical controling apparatus for the motors. Three of the 54 inch units will be located at New York, while four of these units are required for each of the other docks.

Each unit is required to operate against a static head, varying from zero when the dock is full to a maximum of 42 to 44 feet when the dock is completely empty, while operating at a constant speed of 219 revolution per minute without exceeding the rated horse power of the motor at any point. In addition to this each pump is required to maintain an average capacity of 66,000 gallons per minute when emptying the dock from approximately mean high water to one foot above the elevation of the keel blocks, the static head varying from zero to 32 or 34 feet. Under these conditions the contractor has guaranteed an average efficiency of 45 per cent. for New York and Pearl Harbor and 46 per cent. for Puget Sound, these efficiencies being the ratio of the actual useful work in pumping the docks to the electrical input to the motors, and consequently include all losses in the motors, pumps and piping. To meet these average efficiencies it is necessary for the pumps, themselves, to reach a maximum efficiency of nearly 80 per cent.

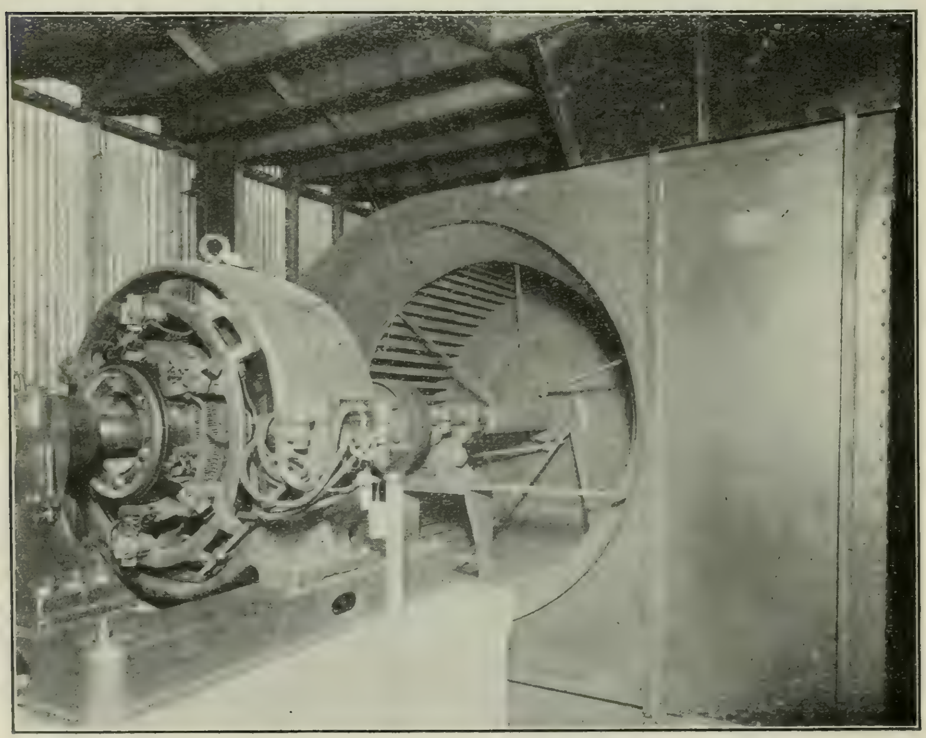
In addition to obtaining a high efficiency, the other characteristics of the pump have to be very carefully determined in order to meet the special conditions involved in this class of work. In fact but few concerns in this country are equipped with the necessary engineering data and experience to undertake work of this character.

Tunnel Ventilation.

ABOUT two months ago, the Hudson & Manhattan Railroad installed at their Washington street power house, Jersey City, N. J., a large double inlet "Sirocco," full housed exhaust fan, for the ventilation of the Hudson Tunnels in that vicinity. An illustration of the outfit is given above.

This apparatus consists of a No. 13 double inlet "Sirocco" full housed fan, with blast wheel 78 inches in diameter by 78 inches wide at periphery, containing 64 blades. Direct attached to the fan shaft by means of a flexible flanged coupling, is a 40 horse power Sprague, slow speed type motor, wound for 600 volts, direct current. Normal speed 175 revolutions per minute, maximum speed 200 revolutions per minute.

The outfit was erected in an air-tight room, the air being exhausted from the tunnels through air-ways and shaft provided for the purpose. There are no connections or ducts between the fan inlets and the air shafts, the air velocity being produced by the suction head maintained in the fan room.

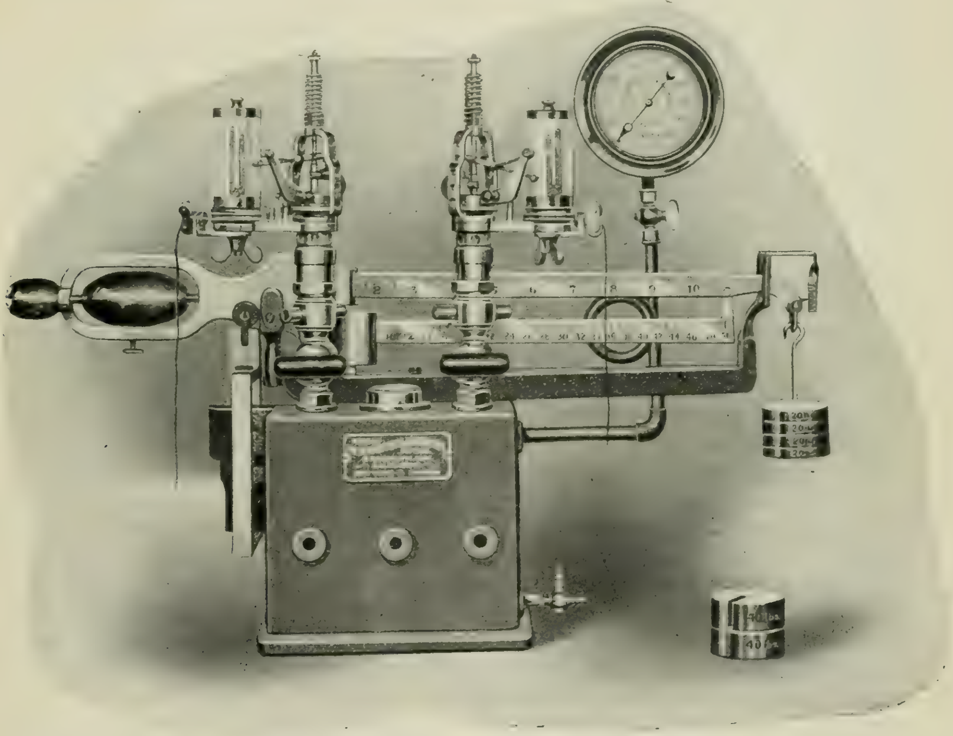


The fan discharges through an evasé stack having a screened outlet hood, similar to those used on mine ventilating fans. The fan was required to exhaust from the tunnels 6,000,000 cubic feet per hour, or 100,000 cubic feet per minute.

Determining the Accuracy of Indicator Springs.

THE indicator is unquestionably the most necessary instrument for the operating engineer. The indicator diagram is the only means to ascertain the action of the steam in the engine cylinder, to determine the efficiency of an engine, and to detect internal wastes. It is, therefore, of vital importance that the indicator be absolutely accurate in its performance, which applies especially to the piston spring, the most essential part of the indicator, unless the exact tension of the spring is known errors will result from its use, and the determinations made with the indicator will be of little or no value. The need for a reliable instrument for testing indicator springs has been filled with the apparatus illustrated herewith.

This apparatus, which is made by the Schaeffer & Budenberg Mfg. Co. of Brooklyn, N. Y., consists essentially of a closed vessel made of cast iron, capable of resisting internal steam pressures up to 200 pounds per square inch. The steam pressure in the vessel is measured by a gauge of special construction consisting of a piston of one-half square inch area and which is free to move in an inclosing cylinder.



The lower portion of the piston is

pointed and rests in a yoke which is suspended on the knife-edge of a pair of scales mounted on top of the closed vessel. If the scales are previously balanced, before admitting steam into the vessel, it is evident that the reading of the scales will give the pressure acting on each element of the vessel equal in area to that of the piston. The scales are graduated to fiftieths of a pound which permits of very close readings.

In testing indicator springs steam is turned into the vessel to gradually warm it and allowed to blow through the connections and indicator cocks to remove any particles of dust or grit which may have accumulated there. Shut off steam again and screw indicator in its place putting paper on the indicator drum, n which paper two vertical lines are ruled.

Press the indicator pencil against the drum and draw a horizontal line at the point thus marked. Then set the poise of the scale at say 5 pounds and admit steam into the vessel gradually rising in pressure until the scale floats. When the pressure is exact draw the line R R and so on for successive pressures of 5 pounds, until the limit of the scale is reached. During this operation the motion of the indicator pencil is continuously kept upward, if at any moment the pressure rises too high, it is lowered by manipulating the valves below the required amount and then gradually raising to the desired point.

When the indicator pencil has reached its highest position, the steam pressure is allowed to fall gradually and a series of similar lines, as W-W, X-X, Y-Y and Z-Z drawn during the descent of the piston. The motion being continuously downward. The distance between any two of these lines as Y-R, Y-S, indicates the loss due to friction of the indicator.

The special advantage of this machine, besides its absolute accuracy, is that the indicator springs are tested in the individual indicator in which they are used and under actual steam pressure which is as near to the actual working conditions as possible. The indicator spring testing apparatus serves also for testing pressure gauges, which can be connected to the three openings in the front side of the vessel provided for that purpose, and the readings are verified by the indications on the scales and the test gauge shown in the illustration.

Sebco Mooring Bolt.

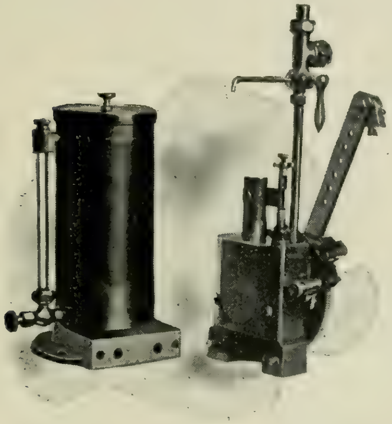
THE Sebco mooring bolts have been adopted by the Department of Docks and Ferries of New York City as the standard bolt for construction work in concrete. These bolts are specially devised for concrete construction. With the new way the Sebco mooring bolt is moulded in the concrete just where it is wanted. The bolts will not bend and the threads will not strip. You get the full strength of the bolt and can renew the bolt with any length desired at any time without redrilling holes. This new method saves the workman's time and labor and there is no loss of material.

The Sebco mooring bolt is manufactured by the Star Expansion Bolt Co., of No. 147 Cedar street, New York City, who will gladly send full information and descriptive matter of this and other Sebco products illustrated in their catalogue to anyone addressing Catalogue Department 56.

Rochester Lubricator.

THE Rochester automatic lubricator is the pioneer in the force feed lubricator field. Its popularity is due to the following reasons:

It is absolutely positive, due to the fact that there is always under pressure a solid column of oil from the lubricator to the point of delivery; it will pump against very high pressures even up to 1,500 pounds and over; due to the positive pump, the temperature makes absolutely no difference, as the same amount of oil will be pumped regardless of whether it is thick or thin; by means of three distinctly different methods of regulation, the amount of oil fed can be regulated so that the lubricator will feed anywhere from the smallest fraction of a drop to an almost continuous stream; the pump block is detachable making it easy to clean or repair the lubricator; there is a double set of ball valves that prevent the clogging of the lubricator, each feed of every lubricator from the one-pint size up is provided with a patent combination multiplus sight feed and three-way cock; all lubricators from the one-pint size up are fully nickel-plated, and because of their appearance are an addition to any engine room; the lubricators are made in all sizes from one-pint to two-gallon and with any number of feeds from one to eight; by their use there is a great saving of oil, time and labor.



The manufacturers, Greene, Tweed & Co., 109 Duane street, New York, will be glad to furnish a complete catalogue to any interested inquirer.

Large Grinding Wheel.

WHAT is believed to be the largest vitrified grinding wheel ever made was recently turned out at the works of the Carborundum Company, Niagara Falls, N. Y. The wheel in question is made of Aloxite, the new steel grinding abrasive recently put on the market by the Carborundum Company. The big wheel is 48 inches in diameter and is to be used for tool grinding by one of the Carborundum customers in France.

Industrial Notes.

—The Stephens-Adamson Mfg. Co., Aurora, Ill., has recently strengthened their organization by securing the services of G. H. Stephens. Mr. Stephens has obtained substantial interests in this company, and has assumed the management of their entire eastern business. The eastern office is at 50 Church Street, New York City. Mr. Stephens has been a prominent factor in the conveying industry for over twenty years. He has a comprehensive knowledge of conveying and screening machinery and a wide acquaintance among the machinery users of the East. The Engineering Department of the New York office is under the charge of J. G. Macrum. Mr. Macrum was formerly associated with Mr. Stephens in business and is recognized as a conveying engineer of ability. Earl D. Stearns, who has ably represented the Stephens-Adamson Co., in the East for the past two years, has taken charge of the company's Chicago office in the First National Bank Building. The Stephens-Adamson Mfg. Co. are manufacturers of a complete line of conveying, elevating, screening and power transmitting machinery. Their main office and shops are at Aurora, Ill.

—H. M. Byllesby & Company of Chicago has acquired control of a number of additional public utility properties in California, including two important water power developments and several water power sites not yet developed. The principal local plants purchased consist of the electric and gas properties formerly owned by the Stockton Gas and Electric Corporation, at Stockton; the electric light and power business at Richmond and the gas and electirc properties at Eureka. The American River Electric Company, which owns a large hydro-electric plant on the American River in Eldorado County, California, and maintains a reserve steam turbine plant at Stockton, is included in the transaction. The Humboldt Gas & Electric Company, operating at Eureka, possesses a considerable water power development in Trinity County, transmitting current to Eureka, 65 miles distant. The American River Electric Company's business includes service to Stockton, Placerville, Florin, Elk Grove, Sheldon, Gault, Lodi and Plymouth by means of long distance transmission lines, which are also extensively utilized for supplying power for gold mining and irirgation purposes. The Humboldt electric business includes service to the towns of Arcata, Alton, Ferndale, Fields Landing, Fortune, Hydesville, Loleta and Rohnersville. Eureka and surrounding towns have a population of 22,000. They are on Humboldt Bay which affords one of the few good harbors on the Pacific Coast. Back of the city lies an immense area of redwood forests. Eureka will soon be connected with San Francisco by a railroad line now under construction. Stockton with suburbs has a population of 30,000, is one of the oldest cities in California and is a manufacturing center of importance. Richmond, a newer town of 12,000 people, lies on San Francisco Bay south of Berkeley. It, also, is a manufacturing center and is the location of large new shops being built by the Pullman Car Company. All three cities have shown wonderful recent growth. A new company known as the Western States Gas and Electric Company, has been formed to hold the stock of the properties described.

—The firm of Dodge, Day & Zimmerman of Philadelphia, have added to their organization Walter Loring Webb and James M. Kennedy, well known in the engineering world. Mr. Webb is the author of several engineering textbooks, including "The American Civil Engineers' Pocket Book," "Economics of Railroad Construction" and "Problems in the Use and Adjustment of Engineering Instruments."

Obituary.

Louis R. Alberger, president of the Alberger Condenser Company and the Alberger Pump Company, 90 West Street, New York, died January 31. Mr. Alberger was one of the best known specialists in the country on pumping machinery and condensing apparatus. After attending Yale University he went in business with his father, who was engaged in the manufacture of vacuum process specialties used in the salt industry. In 1887 Mr. Alberger became connected with the Henry R. Worthington plant, afterward a part of the International Steam Pump Company. He left the Worthington organization in 1901, when he formed the Alberger Condenser Company and acquired the plant of the Newburgh Engine & Ice Machine Co. at Newburgh. Shortly afterward he formed the Alberger Pump Company.

George Q. Palmer, formerly vice-president, has been made president of the Alberger Condenser Company, and the Alberger Pump Company. Mr. Palmer is succeeded as vice-president in the Alberger Condenser Company by D. H. Chester, and in the Alberger Pump Company by W. S. Doran.

BINDING SECT. AUG 14 1980

TA
1
F25
v.40

Engin.

Factory and industrial
management

ENGIN STORAGE

PLEASE DO NOT REMOVE
CARDS OR SLIPS FROM THIS POCKET

UNIVERSITY OF TORONTO LIBRARY